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Planetology

6510 Atmospheres of Planets
A TWO DIMENSIONAL MODEL OF THE IONOSPHERE OF VENUS
T. E. Cravens, S. L. Crawford, A. F. Nagy, and T. I. Gombosi (Space Physics Research Laboratory Department of Atmospheric and Oceanic Science, The University of Michigan, Ann Arbor, Michigan 48109)

A substantial nightside ionosphere has been observed on Venus during most orbits of the Pioneer Venus Orbiter. However, on some orbits during which the solar wind dynamic pressure was large, the nightside ionosphere seems to have almost disappeared, existing only as irregular patches of low density plasma. We interpret these observational results using a two-dimensional theoretical model of the ionosphere of Venus in which empirical horizontal velocities are adopted. We show that the degree to which horizontal transport of ions from day to night can maintain the nightside ionosphere depends on two parameters: 1) the flow velocities, and 2) the ionopause height at the terminator. We also investigate the role of electron precipitation in supporting a nightside ionosphere. Our model also provides indirect evidence for an enhanced deuterium to hydrogen ratio on Venus.
J. Geophys. Res., Blue, Paper 3A0462

6510 Atmospheres of planets
CO_2 ON TITAN
R. E. Samuelson, W. C. Maguire, R. A. Hanel, V. G. Kunde, D. E. Jennings (Laboratory for Extraterrestrial Physics, Code 693, Goddard Space Flight Center, Greenbelt, Maryland, 20771), Y. L. Yung (Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California, 91125), and A. C. Aikin (Laboratory for Planetary Atmospheres, Code 964, Goddard Space Flight Center, Greenbelt, Maryland, 20771).

A sharp stratospheric emission feature at 667 cm^{-1} in the Voyager infrared spectra of Titan is associated with the ν_2 Q-branch of CO_2. A coupling of photochemical and radiative transfer theory yields an average mole fraction above the 110 mbar level of $f_{CO_2} = 1.5^{+1.5}_{-0.8} \times 10^{-9}$, with most of the uncertainty being due to imprecise knowledge of the vertical distribution. CO_2 is found to be in a steady state, with its abundance being regulated principally by the ~ 72 K cold trap near the tropopause, and secondarily by the rate at which water-bearing meteoritic material enters the top of the atmosphere. An influx of water about 0.4 time that at the top of the terrestrial atmosphere is consistent with a combination of the observed CO_2 abundance and a steady state CO mole fraction of 1.1×10^{-4}; the theoretical value for CO is comparable to the observed value, although there is a large margin for error in both numbers. If steady state conditions for CO prevail, little information is available regarding the evolution of Titan's atmosphere. (Carbon dioxide; Photochemistry, Titan).
J. Geophys. Res., Blue, Paper 3A0453

6510 Atmospheres of planets (Mars)
THE THERMAL STRUCTURE OF THE ATMOSPHERIC SURFACE BOUNDARY LAYER ON MARS AS MODIFIED BY THE RADIATIVE EFFECT OF AEOLIAN DUST
Albert J. Pallmann (Department of Earth and Atmospheric Sciences, Saint Louis University, St. Louis, Missouri 63103)

A 52-level time-dependent radiative-convective-conductive heat transfer model, paired with a 30-level ground conduction subroutine and a detailed soil-atmosphere heat balance equation, is applied to heavy and slight dust-laden atmospheric conditions of Mars. High spectroscopic, spatial, and temporal resolution is necessary to approximate the thermal structure of the atmospheric surface boundary layer under both conditions. The results show that heat is effectively exchanged across the surface layer, even in the absence of turbulent convection, by means of weak-line and strong-line transmission of radiant energy in both the solar (short-wavelength) and planetary (long-wavelength) domains. The diurnal temperature variation at the top of the boundary layer (~ 20 m) covers about 75% of that of the surface in opaque dust-laden and about 60% under thin dust conditions. The dust phase diminishes the spectral sappiness inherent in the CO_2 absorption bands, within the solar and planetary infrared.
J. Geophys. Res., Green, Paper 3C0381

6530 Gross properties of planets
MAGNETIC FIELDS IN THE IONOSPHERIC HOLES OF VENUS: EVIDENCE FOR AN INTRINSIC FIELD?
J. G. Luhmann (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024) and C. T. Russell

The suggestion that the radial magnetic fields observed in the regions of depleted plasma density in the nightside Venus ionosphere arise from an intrinsic planetary field was recently made by Knudsen et al. (1982). In this report the polarities of these radial fields, as measured by the Pioneer Venus Orbiter magnetometer, are examined in detail in order to determine if there is a geographical organization of the field polarity, or if the polarity of the radial field depends on the interplanetary field as previously proposed. The results of the data analysis indicate that a source in a planetary intrinsic field is unlikely.
Geophys. Res. Lett., Paper 3L0332

6570 Surface of moon (Composition)
THORIUM CONCENTRATIONS IN THE LUNAR SURFACE: IV. DECONVOLUTION OF THE MARE IMBRIUM, ARISTARCHUS, AND ADJACENT REGIONS
Maria I. Etchegaray-Ramirez (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109), Albert E. Metzger, Eldon L. Haines, B. Ray Hawke.

The distribution of Th over the Mare Imbrium and northern Oceanus Procellarum portions of the Apollo 15 lunar ground track has been modeled by deconvolving several fields of orbital gamma ray spectroscopy data. Including a prior study of the Apennines region, a continuous swath from 10°E to 60°W in the northwest quadrant has now been analysed. In the Aristarchus region, the crater dominates the Th distribution with a concentration of 20 ppm. Other enhancements are seen on the Aristarchus Plateau and south of the plateau. The concentration across the Aristarchus Plateau is not uniform. The average Th concentration in Oceanus Procellarum is less to the west than to the east of the Aristarchus Plateau. Substantial enhancements are found in mare regions around Brayley, and at the ejecta blankets of Timocharis and Lambert. Th in the Eratosthenian mare regions is generally low with one notable exception lying roughly between the craters Euler and Carlini. The existence of enhanced Th concentrations in mare basalt regions suggests that reservoirs of some late stage mare basalts incorporated KREEP-rich material during formation or transit. (Remote sensing, gamma ray spectroscopy)
J. Geophys. Res., Red, Paper 2B1626

6570 Surface of moon
GLOBAL MULTISPECTRAL MOSAICS OF THE ICY GALILEAN SATELLITES
T. V. Johnson (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA), L. A. Soderblom, J. A. Mosher, G. E. Danielson, A. F. Cook and P. Kupferman

Multispectral mosaics of the three icy Galilean satellites have been produced from low to moderate resolution Voyager images. The digital image data have been calibrated using pre-flight and in-flight calibration data and reduced to normal albedos for four color bandpasses, centered at 0.35, 0.41, 0.48 and 0.59 micrometers. The individual images have been geometrically corrected, mosaiked and presented in a global cylindrical map projection at a uniform scale of 8 km per pixel. Preliminary analysis of the normal albedo data shows that: 1. the darkest terrains on the satellites are the dark regions on Callisto, 2. the brightest regions are bright plains regions on Europa and bright, fresh craters on Ganymede, 3. bright craters on Ganymede and its dark cratered regions are both significantly brighter than comparable terrains on Callisto and 4. Europa exhibits several distinct spectral units, with regions on the trailing hemisphere having lower relative ultraviolet spectral reflectance than areas on the leading hemisphere. This is consistent with proposals that Io-related plasma impact on Europa's trailing side has altered its optical properties. (Galilean Satellites, Multispectral imaging, Voyager results).
J. Geophys. Res., Red, Paper 1B0430

Seismology

6950 Seismic sources
LAMB PULSE OBSERVED IN NATURE
Hiroo Kanamori (Seismological Laboratory, California Institute of Technology, Pasadena, California 91125) and J. Given

Seismograms observed at Longmire, Washington, for four eruptions of Mt. St. Helens (May 18, June 12, August 7, and August 8, 1980), can be interpreted as Lamb pulses excited by a nearly vertical single force that represents the counter force of the eruption. These data provide reliable estimates of the impulse of the force K (time integral of the force) from which the total momentum and the kinetic energy, E, of the ejecta associated with the eruption can be estimated. The values of K are estimated to be 1.4×10^{19}, 1.4×10^{16}, 3.7×10^{15}, and 2.8×10^{15} dyne s for the four eruptions (chronological order), respectively. The corresponding values of E are estimated to be $0.70 \sim 2.6 \times 10^{23}$, $0.70 \sim 2.6 \times 10^{20}$, $1.9 \sim 6.9 \times 10^{19}$, and $1.4 \sim 5.3 \times 10^{19}$ ergs using values of ejecta velocity ranging from 100 to 375 m/s. The ratios of K to the amplitude of the air wave excited by the eruption is 20 to 40 times larger for the main event on May 18 than for the other events suggesting a significant difference in the eruptive mechanism. Our results demonstrate that a digital seismograph in the vicinity of volcanoes provides a simple means for quantification of the explosive power of a volcanic eruption. (Mt. St. Helens, Lamb pulse, quantification of volcanic eruption, air wave).
Geophys. Res. Lett., Paper 3L0352

6950 Seismic Sources (Aftershock Space and Time Distribution)
EXPANSION OF THE AFTERSHOCK ZONE FOLLOWING THE VANUATU (NEW HEBRIDES) EARTHQUAKE ON 15 JULY 1981
J.-L. Chatelain (Office de la Recherche Scientifique et Technique Outre-Mer, Noumea, New Caledonia), R.K. Cardwell and B.L. Isacks (Geological Sciences, Cornell University, Ithaca, NY 14853)

Following a large (M_s=7.0), interplate earthquake on 15 July 1981 in the Vanuatu (New Hebrides) Islands, the area defined by the aftershocks dramatically increased over a two week period of time. The aftershocks were located using the Cornell/ORSTOM seismograph network that has been monitoring earthquakes with magnitudes larger than m_b=2.9 in the region since mid-1978. In the first few hours following the mainshock, the area defined by the aftershocks was consistent with the rupture zone of a typical interplate earthquake with the observed seismic moment of 5.8×10^{26} dyne-cm. However, during the 16 days following the mainshock, the area of the aftershock zone increased to approximately 10 times the area of expected coseismic rupture. The final aftershock zone included earthquakes that were located within the overriding and descending plates as well as along the interplate fault zone. The migration of aftershocks away from the rupture zone of the 1981 mainshock indicates that, at least in some cases, the aftershock zone can overestimate the extent of coseismic rupture.
Geophys. Res. Lett., Paper 3L0495

News

$^3He/^4He$ Values in Natural Diamonds

Values of the $^3He/^4He$ ratio in natural diamond crystals appear to be higher than the so-called primordial ratios observed in meteorites, according to a recent report by Minoru Ozima and Shigeo Zashu of the Geophysical Institute at the University of Tokyo (*Science*, March 4, 1983). The values obtained from helium fractions of 13 diamonds ranged from less than 10^{-7} to $3.2 \pm 0.25 \times 10^{-4}$, indicating a rather large enrichment of primitive helium. The measured ratios are close to those for solar-type helium.

The significance of those determinations could be two-fold, raising questions about the interpretation of helium isotope ratios from other surface samples and from other terrestrial sources. A possibility is that the diamonds may have originated in a deep, chemically isolated, and decoupled part of the earth's mantle. The problem is that this decoupling would have to be total, implying essentially no communication of the deep mantle with the rest of the earth. Ozima and Zashu prefer to think that the diamonds themselves preserved the helium ratio of a very primitive environment by being unusually depleted in uranium and thorium. This latter explanation, if correct, would mean that in at least one case, i.e., these diamonds, one cannot determine the geological evolution of $^3He/^4He$ reliably.

The study used 13 individual, industrial-grade diamond crystals of 1–2 carats each. A serious problem with the interpretation of the helium isotope ratios measured on the crystals could be that their origin is unknown. The diamonds are thought to have come from more than one South African mine, no specific location having been specified.

Two of the diamonds' ratios are 2 to 3 times higher than the accepted primordial value of meteorites ($^3He/^4He = (142 \pm 2) \times 10^{-2}$ according to J. H. Reynolds, V. Frick, J. M. Neil, and D. L. Phinney, *Geochim. Cosmochim. Acta*, *42*, 1775, 1978), and on the order of ratios for solar-type helium. There was a wide range of values among the set of 13 stones. Ozima and Zashu postulate that the ratios are indigenous to their origins in the mantle. That the wide variation could be due to products of a nuclear reaction seems unlikely. The diamonds could have been in residence in the crust in diamond pipes for over 1 billion years, long enough to have taken a high dosage from the thermal neutron flux. But the reaction to produce ^3He is the following:

$$^6Li\,(n,\alpha)\,^3H \rightarrow {}^3He$$

About four orders of magnitude more lithium (Li) than is thought to exist in crustal rocks would have been required, however, to produce the observed concentrations of ^3He.

The other way to affect the helium ratio is to add radiogenic ^4He, and this is the process proposed to explain the results. The ^4He could have been enriched in the source mantel regions or could have been added, perhaps to the diamonds themselves. The explanation of Ozima and Zashu is as follows: 'Diamonds with higher $^3He/^4He$ values (7×10^{-6}) may represent very primitive helium that evolved little since the formation of the earth. Preservation of such primitive helium throughout a geological age would be possible only in an environment where uranium and thorium contents are generally extremely small (≤0.1 ppb).' The idea proposed is that the high helium ratios are representative of a perfect process that trapped primitive helium soon after the earth was formed. In the case of the lower helium ratios, either a high uranium and thorium environment is implied, or else the diamonds are younger. Younger diamonds would have trapped more evolved or 'aged' helium deep in the upper mantle.

Another observation related to the ^3He contents of the lower ratio diamonds is used as basis for extending the young-old hypothesis even further. Diamonds with lower ratios have significantly lower absolute contents of ^3He. Could it be that the smaller amounts of ^3He reflect a relatively outgassed mantle?

Ozima and Zashu note that the solar-type helium ratios could be due to a different mode of accretion of the earth than the accretionary stages that produced parent bodies of meteorites. Accretionary particles that formed the primordial earth may have been irradiated by intense primitive solar wind. In this hypothesis, meteorites would have trapped only planetary helium.—*PMB*

Monsoon Research

Forecasting monsoons is one of four research areas proposed as part of an expanded program of collaborative projects by U.S. and Indian scientists and engineers, according to George A. Keyworth, II, science advisor to President Reagan and director of the Office of Science and Technology Policy (OSTP). The other proposed research areas are health, agriculture and biomass production, and decentralized electrical power sources.

During the next 6 months, scientists will 'scope out research projects' and detail specific research activities, according to Roger Doyon, head of the Africa and Asia section of the National Science Foundation's (NSF) Directorate for Scientific, Technological, and International Affairs. Most of the actual research will begin with the advent of fiscal 1984.

Research on the long-term variability of monsoons and short-term predictability will be the focuses of the monsoon forecasting effort. India and the United States have agreed to 10 general tasks as part of this program, according to Pam Stephens, associate program director for the Global Atmospheric Research Program within NSF's Division of Atmospheric Sciences. Six of these tasks apply to the long-term variability portion of the research effort:

- develop long-term data records,
- prepare and compile data records from other areas of the world,
- conduct theoretical and statistical studies to understand monsoons and the global atmospheric and oceanic circulations,
- investigate ocean–atmosphere interactions as they affect monsoons and plan field studies and modeling experiments to take place during the first year of the agreement,
- conduct experiments with general circulation models to explore long-term predictability, and
- obtain ice cores in glaciers to provide proxy data for studies of interannual variability.

J. Shukla of the National Aeronautics and Space Administration's Goddard Laboratory for Atmospheric Science is the program leader.

The remaining four tasks apply to the short-term predictability portion of the bilateral effort on monsoon forecasting:

- develop mathematical models suitable for numerical prediction of monsoons,
- develop systems for acquisition and processing of initial data,
- develop techniques and provide equipment for processing satellite data and for archiving it, and
- conduct basic research on monsoon dynamics.

T. N. Krishnamurti of Florida State University is the program leader.

Monsoon forecasting and the three other research fields were first explored last November during a visit to India by senior U.S. scientists; specific topics were agreed upon by a panel of scientists from both countries following a meeting this past January in India. After the first phase of the program (which will last 18 to 24 months), another set of research projects could be identified for a continuation of the collaborative effort.

In the U.S., overall coordination of the bilateral research will be provided through NSF, while policy guidance will be provided by an interagency committee chaired by Keyworth. A scientific oversight committee at the National Academy of Sciences will recommend participants and will review specific projects. The amount of money each country will contribute has not yet been determined, according to OSTP and NSF.—*BTR*

AGU Awards Announced

AGU has named the 1983 recipients of the Bowie, Bucher, Ewing, Fleming, and Macelwane awards. These distinctive honors recognize AGU members who make significant contributions to geophysical knowledge. All of the awards except the Bucher medal will be presented at a ceremony on Wednesday, June 1, at the AGU Spring Meeting in Baltimore, Md. This year the Bucher Medal will be presented at the AGU Fall Meeting.

AGU is adding to its roster of distinguished awards the Waldo E. Smith Award for extraordinary service to geophysics. The premier award will be made at the 1983 Spring Meeting to AGU Executive Director Emeritus Waldo E. Smith.

The ***William Bowie Medal*** is awarded to ***Syun-iti Akimoto*** for outstanding contributions to fundamental geophysics and for unselfish cooperation in research.

The ***Walter H. Bucher Medal*** is awarded to ***John W. Handin*** for original contributions to the basic knowledge of the earth's crust. The medal is awarded in odd-numbered years.

The ***Maurice Ewing*** medal is awarded to ***Fred Noel Spiess*** for significant original contributions to the understanding of physical, geophysical, and geological processes in the ocean; for significant, original contributions to scientific ocean engineering, technology, and instrumentation; and for outstanding service to marine sciences. The medal is presented jointly by the U.S. Navy and AGU.

The ***John Adams Fleming Medal*** is awarded to ***S. Keith Runcorn*** for original research and technical leadership in geomagnetism, atmospheric electricity, aeronomy, and related sciences. The medal is awarded in odd-numbered years.

The ***James B. Macelwane Award*** is given in recognition of significant contributions to the geophysical sciences by a young scientist of outstanding ability. The recipient must be less than 36 years old. A maximum of three awards can be made each year. This year's recipients are ***Thomas H. Jordan, Donald J. DePaolo, and William L. Chameides.***

The Robert E. Horton Medal for outstanding contributions to the geophysical aspects of hydrology is given in even-numbered years. A complete list of AGU medal recipients was published in the most recent membership directory (*Eos*, August 31, 1982, p. 664).—*BTR*

Geophysicists

Bruce B. Hanshaw, a specialist in geochemistry and groundwater hydrology, has been appointed assistant director for research at the U.S. Geological Survey (USGS) National Center in Reston, Va. He succeeds ***Robert Wesson***, who has returned to a research position within the USGS. Hanshaw will serve as the principal advisor to the USGS director on major research initiatives and program directions.

Lawrence R. Lyons, of the NOAA Space Environment Laboratory in Boulder, Colo., has accepted a position in the magnetospheric physics branch of the Space Science Laboratory at NASA's Marshall Space Flight Center in Huntsville, Ala.

Forum

More on Pentagon Funding Ties

Emotional Dependence

Richard Altrock's recent letter on Air Force funding of geophysical research (*Eos*, March 22, 1983, p. 114) raises a number of questions in my mind and I am sure in the minds of many others. Dr. Altrock states that 'funding is determined purely on *relevance*, availability of funds, and our estimate of the quality of the proposed research' (emphasis mine). Relevant to whom? I assume that the Air Force seeks research relevant to its long-range interests which I regard as contrary to the long-range interests of the human race.

Dr. Altrock argues that 'acceptance of financial support from military sources [does not] make individuals and institutions dependent clients of the Pentagon.' Indeed, the Air Force cautions those it supports 'not to become too dependent upon Air Force funds.' But dependence does not necessarily mean financial dependence. The dependence of geophysicists upon the Air Force is more of a moral, or even emotional, dependence. It is difficult to think ill of someone who is giving you money. How bad can the Air Force be if they support my research on synthetic seismograms?

I hope that I shall continue to receive support from nonmilitary sources. One of my great fears is that our society may become so militarized that it will become impossible both to do scientific research and to noncooperate with the military.

Steven H. Emerman
Dept. of Geological Sciences
Cornell University
Ithaca, NY 14853

Proposals as Votes

Mr. Altrock is quite correct in pointing out that research scientists with Air Force contracts are not 'clients' of the Pentagon. But he does not deal with a much more important question: does a scientist who solicits funds from a government agency thereby indicate basic approval of this agency's policy? It seems to me that the answer is positive: the more proposals the Pentagon receives, the more it can turn to higher authorities to ask for more funds for those, and the greater its power becomes. Yes, each proposal has only a very small effect, but on election day each ballot has an even smaller one. Each of us must take his/her responsibilities: democracy does not stop after election day.

J.-Cl. De Bremaecker
Rice University
Houston, TX 77251

In Memoriam

Alfred C. Redfield, 92, died on March 17, 1983. An AGU Life Fellow, he joined AGU's Oceanography section in 1947.

Books

New Publications

Items listed in New Publications can be ordered directly from the publisher; they are not available through AGU.

Atmosphere, Weather and Climate, 4th ed., R. G. Barry and R. J. Chorley, Methuen, New York, xxiv + 407 pp., 1982.

Handbook of Chemical Microscopy, Vol., I, 4th ed., C. W. Mason, Wiley, New York, xv + 505 pp., 1983, $69.95.

Introduction to Environmental Remote Sensing, 2nd ed., E. C. Barrett and L. F. Curtis, Chapman and Hall, New York, xiv + 352 pp., 1982.

Les Granites Des Complexes Annulaires, B. Bonin, *Manuels et Methodes*, vol. 4, Bureau de recherches geologiques et minieres, Orléans, France, 193 pp., 1982.

Long-Time Prediction in Dynamics, C. W. Horton, Jr., L. E. Reichl, and V. G. Szebehely (Eds.), Wiley, New York, xv + 496 pp., 1983, $85.00.

Mountain Building Processes, K. J. Hsü (Ed.), Academic, New York, x + 263 pp, 1983, $72.50.

On the Performance Property in Spherical Spline Interpolation, by W. Freeden, *Rep. 341*, Department of Geodetic Science and Surveying, Ohio State University, Columbus, v + 88 pp., 1982.

Proceedings of Coastal Structures '83, J. Weggel (Ed.), A Specialty Conference on the Design, Construction, Maintenance, and Performance of Coastal Structures, Am. Soc. Civ. Eng., New York, xiii + 10123 pp., 1983, $76.00.

Random Fields: Analysis and Synthesis, E. Vanmarcke, MIT Press, Cambridge, Mass., xiv + 382 pp., 1983, $45.00.

Theories of Mutation and Polar Motion, 3, H. Moritz, *Rep. 342*, Department of Geodetic Science and Surveying, Ohio State University, Columbus, vii + 116 pp., 1982.

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For further information, call toll free 800-424-2488 or, in the Washington, D. C., area, 462-6903.

POSITIONS AVAILABLE

Agricultural Drainage Engineer. Assistant Professor, tenure track position in the Departments of Land, Air and Water Resources and Agricultural Engineering, 35% teaching and 65% research. Ph.D. in soil physics, agricultural engineering or related field with one degree in engineering with a strong background in flow and solute-water interactions in porous media, mathematical and computer simulation modeling skills, and competence in design and evaluation of agricultural drainage systems.

Teaching responsibilities include advising, instructing undergraduate level course descriptive of soil water flow, solute transport and agricultural drainage systems, and another in drainage system design. At the graduate level, a course in groundwater flow is required. Research in the detailed processes occurring in shallow groundwater is expected to provide management alternatives and drainage design criteria for cropped areas and for drain water reuse.

Applicants should submit curriculum vita, transcripts, statement of research and teaching interests and background in each, copies of publications and manuscripts and the names and addresses of at least three references to: Professor D.R. Nielsen, Chair, Search Committee, Department of Land, Air and Water Resources, 121 Veihmeyer Hall, University of California, Davis, CA 95616, by July 15, 1983.

THE UNIVERSITY OF CALIFORNIA IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER AND INVITES APPLICATIONS FROM ALL QUALIFIED INDIVIDUALS.

Two Tenure Track Faculty Openings in the Coastal and Oceanographic Engineering Department/ University of Florida. Applications are invited for faculty positions in the area of oceanographic engineering. Candidates should have earned a Ph.D. degree with a strong commitment to developing research. Experience in one or more of the following areas is highly desirable: Offshore engineering, marine structure design, materials in marine environment, remote sensing applications and laboratory and numerical modeling of coastal, bay and estuarine environment. Other specialties in coastal and oceanographic engineering will also be considered. Ranks (professor/associate professor/assistant professor) and salaries commensurate with qualifications. Anticipated starting date of August 5, 1983. A detailed resume, academic transcripts and three letters of recommendation should be sent to: Dr. M.K. Ochi, Search Committee Chairman, Coastal and Oceanographic Engineering Department, 336 Weil Hall, University of Florida, Gainesville, FL 32611. Postmark before June 30, 1983 deadline.

The University is an equal opportunity/affirmative action employer.

Assistant Professor/University of Alberta. The Department of Physics at the University of Alberta invites applications for a tenure track position at the level of an Assistant Professor in Physics in any of the following areas:

1. Astrophysics and Astronomy;
2. Geophysics (Electromagnetic methods);
3. Theoretical Physics (Medium Energy, Particle Physics, Relativity and Cosmology).

The 1982/83 salary range for an Assistant Professor is $27,720–$39,820 per annum.

Applications will be received until May 1, 1983, and the expected appointment date is July 1, 1983.

The Department of Physics offers both undergraduate and graduate degrees in Physics and Geophysics. The Department currently consists of 47 Faculty Members, 36 Research Associates and Post-Doctoral Fellows and 50 Graduate Students.

Candidates interested in applying should submit a curriculum vitae plus the names of three (3) referees to:

Dr. A. N. Kamal
Chairman
Department of Physics
University of Alberta
Edmonton, Alberta, Canada
T6G 2J1

The University of Alberta is an equal opportunity employer but, in accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

Biometeorology/University of California. The Department of Land, Air, and Water Resources, University of California, Davis, announces a position in the area of biometeorology. Tenure track (11 months) position will be divided 50% teaching and 50% research. The appointment will be at the Assistant or Associate Professor level, depending on qualifications.

QUALIFICATIONS: a ph.d. in atmospheric science or a closely related discipline, with a specialization in the interactions between the atmosphere and the biosphere. Applicants should have teaching and research interests in biometeorology and be able to demonstrate an ability to describe physical/biological sytems with experimental and theoretical techniques. The appointee will be expected to direct research activities in biometeorology towards problems important to California agriculture. Teaching may include both undergraduate and graduate courses in biometeorology, undergraduate courses in general areas of atmospheric science, and advising responsibilities.

APPLICANTS: Applicants should submit curriculum vita, transcripts, statement of research and teaching interests and background in each, copies of publications and manuscripts and the names and addresses of at least three references to: R.H. Shaw, Chair, Search Committee, Department of Land, Air and Water Resources, 177 Hoagland Hall, University of California, Davis, CA 95616, no later than June 15, 1983.

THE UNIVERSITY OF CALIFORNIA IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER AND INVITES APPLICATIONS FROM ALL QUALIFIED INDIVIDUALS.

Research Positions for Mathematical Physicists. Applications are invited for several research positions at the Center for Studies of Nonlinear Dynamics, La Jolla Institute, beginning summer 1983. Current research involves work on nonlinear wave-wave interactions, acoustic, optical, and radio wave propagation in random media, and fluctuation phenomena in the statistical mechanics of chemical and geophysical systems. Physicists and applied mathematicians who are interested in working on problems of the above type should send resumes and arrange for three letters of recommendation to be sent to Dr. Stanley Flatte, Director, CSND, La Jolla Institute, 8950 Villa La Jolla Drive, Suite 2150, La Jolla, California 92037.

La Jolla Institute is an equal opportunity/affirmative action employer.

Mesoscale Research Section of the Atmospheric Analysis and Prediction Division (AAP) Ph.D. Scientist I or II (Two Positions). The National Center for Atmospheric Research in Boulder, Colorado is recruiting for Scientist I or II to do basic research studies on small-scale or mesoscale meteorology. The research will be selected and defined in collaboration with the senior staff. The primary emphasis will be in advancing the fundamental understanding of important mesoscale processes and their interactions with smaller scales of motion. Both theoretical and observational studies will be encouraged; the main goal is to improve the skill of mesoscale forecasting.

REQUIRES (LEVEL I):

- Ph.D. dissertation or equivalent research contribution in meteorology or related field
- Demonstrated expertise/interest in small-scale or mesoscale meteorology
- Demonstrated skill in effective written and oral communication
- Strong mathematical background

ADDITIONAL REQUIREMENTS (LEVEL II):

- Several years of research experience in mesoscale meteorology or related area
- Publication record reflecting the quality and productivity of past research

Salary range: 82, $25,811—$38,722/year, (LEVEL I) 83, $30,977—$46,465/year, (LEVEL II)

Note: the Scientist I and II appointments are terms of up to three and four years respectively. Individuals may then be appointed to II or III position in accordance with UCAR policy.

Send resume PROMPTLY to Esther Blazon, NCAR, P.O. Box 3000, Boulder, CO 80307, or call (303) 494-5151, Ext. 581 or 666 for information.

Equal Opportunity Employer.

Postdoctoral Position in Physical Oceanography. A postdoctoral appointment in physical oceanography will be available beginning September, 1983 in the College of Marine Studies, University of Delaware, Newark, DE. The initial appointment will be for one year with probable extension for a second year. The salary will be $20,000—$24,000 per year, depending on experience. Funds for the position will be available largely from a grant by NSF for conduct and analysis of a field observational study of the shelfbreak front in the Middle Atlantic Bight.

The person obtaining the appointment would be responsible for a portion of the planning and execution of the field study, much of the subsequent data analysis and interpretation, and teaching of one graduate level course in physical oceanography each year. The successful applicant must have received the Ph.D. in physical oceanography or a closely related field by the starting date of his appointment. Preference will be given to applicants with direct experience in field observations.

To apply send a complete resume and the names of three references to Professor R.W. Garvine, College of Marine Studies, University of Delaware, Newark, DE 19711. (Telephone: 302-738-2169).

The University of Delaware is an equal opportunity/affirmative action employer.

Chairman—Department of Geological Sciences, Wright State University. The Department of Geological Sciences, invites applications for the position of chairman, to be appointed September 1984. We seek a dynamic individual with administrative talent and an appreciation for research and practice-related educational activities. Rank is at the full professor level and no restrictions have been placed on areas of specialization. The department is active with 12 faculty and an emphasis on professional practice, yet maintaining a firm commitment to basic research.

Send a letter of application, curriculum vitae and names of three references to:

Chairman, Search Committee
Department of Geological Sciences
Wright State University
Dayton, OH 45435.

Wright State University is an affirmative action/equal opportunity employer. Closing date for the position is October 31, 1983.

Assistant Research Oceanographer Position. The Center for Coastal Studies, Scripps Institution of Oceanography, has an opening for a physical oceanographer with a general background in nearshore processes with emphasis on field and remote sensing investigations of surface gravity waves.

Incumbent will be expected to conduct field and remote sensing experiments of wave properties, dynamics and climatology in the nearshore environment. Responsibilities will also include design and implementation of surface gravity wave measurements supporting a variety of other nearshore processes investigations.

Minimum qualifications for this position are the Ph.D. degree in oceanography and a demonstrated publication record. Successful candidate should have previous field experience as well as demonstrated expertise in wave propagation theory, array design and data adaptive directional spectrum estimation theory. High levels of skill in oral and written communication are necessary.

Appointment in the University of California system is for 1 or 2 years (renewable) and will be at the Assistant Research I, II, or III level, salary from $22,900-$25,200, commensurate with qualifications. Submit resume, indicating an interest in this specific position together with a minimum of three references, before 4 May 1983, to:

D. L. Inman, Director, Center for Coastal Studies
A-009, Scripps Institution of Oceanography
University of California-San Diego
La Jolla, CA 92093.

SIO/UCSD is an Equal Opportunity/Affirmative Action Employer.

Research Associate/Space Physics. Applications are invited for a research associate to assist in the analysis and interpretation of data from a network of midlatitude magnetometers with special emphasis on geomagnetic pulsation and substorm studies. The position is available September 1984 and is for a period of two years.

Ph.D. and a background in magnetospheric physics required; experience with time-series analysis an advantage.

Send resume, bibliography and the names of three persons from whom recommendations may be obtained to Dr. W.J. Hughes, Astronomy Department, Boston, MA 02215.

Boston University is an affirmative action/equal opportunity employer.

Postdoctoral Research Assistantships/ UCLA. The Space Physics Group at UCLA invites applications for a postdoctoral research position which will become available in October 1983. The position entails the analysis and interpretation of magnetometer data in both earth and planetary orbits. Experience in data analysis and the ability to undertake independent research and communicate the results of the research are required. Computer programming experience is highly desirable. Terms of employment and salary to be determined by the qualifications of the applicant. Inquiries should be directed to C.T. Russell, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90024. Applications should be accompanied by a resume, a complete bibliography and at least two names of references who are well acquainted with the applicant's background and potential. UCLA is an equal opportunity/affirmative action employer.

American Mathematical Society
Society for Industrial and Applied Mathematics

Large-scale Computations in Fluid Mechanics

June 27–July 8, 1983

Scripps Institution of Oceanography
University of California, San Diego
La Jolla, California

The fifteenth AMS-SIAM Summer Seminar in Applied Mathematics will be held June 27–July 8, 1983, and will take place at the Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California. The seminar will be sponsored jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics, with anticipated financial support from federal agencies. The members of the organizing committee are Alexandre J. Chorin (University of California, Berkeley), Bjorn E. Engquist (University of California, Los Angeles), Stanley J. Osher (University of California, Los Angeles), and Richard C. J. Somerville, chairman (University of California, San Diego).

The purpose of this seminar is to bring scientists interested in computational fluid mechanics together with numerical analysts and mathematicians working in large-scale computations.

The numerical modeling includes geophysical problems such as those of the atmosphere, ocean, and interior of the earth and planetary, solar, and stellar atmospheres. Applications range from idealized turbulence in laboratory convection models to operational weather prediction. Engineering applications include aerodynamics, combustion, and flow in porous media.

Recent advances in numerical analysis which have applications to these problems will be stressed. These include shock computational algorithms, spectral methods, boundary treatments, vortex methods and parallel computing.

Application blanks for admission and/or financial assistance can be obtained from the Meetings Department, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940. An applicant should have completed at least one year of graduate school and will be asked to indicate his or her scientific background and interest. A graduate student's application must be accompanied by a letter from his or her faculty advisor concerning the applicant's ability and promise. Those who wish to apply for a grant-in-aid should so indicate on the application form; however, funds available for the seminar are limited and individuals who can obtain support from other sources should do so. Questions concerning the scientific program may be addressed to: Professor Richard C. J. Somerville, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California 92093.

Research Position/Space Physics. The Space Physics and Astronomy Department at Rice University seeks applicants for one or more full-time research positions within the department. Successful applicant(s) will play key role(s) in the development of theoretical three dimensional models of the Earth's electromagnetic field. Applicants should have knowledge of, and interest in, at least one of the following areas: solar-wind magnetosphere interactions, magnetosphere ionosphere coupling, ionosphere-atmosphere coupling, atmospheric electricity. Experience and/or interest in numerical modeling is an important consideration.

Title and salary level commensurate with experience, ranging from one-year Research Associateship (renewable in subsequent years depending on performance) to open-ended Research Scientist appointment in the Center for Space Physics. Please send resume and names of three professional references to T. W. Hill or R. A. Wolf, Space Physics and Astronomy Department, Rice University, Houston, TX 77251.

The University is an equal opportunity/affirmative action employer.

Temporary Position: Igneous Petrology and Geophysics/ University of Montana. Applications are invited for one sabbatical replacement at the instructor or assistant professor level for winter and spring quarters of 1983–84 academic year. The period of contract obligation will be approximately January 3, 1984 to June 8, 1984. A graduate student who will have completed a doctorate before September 1983 or anticipates completion sometime during the period of employment would be appropriate for this division.

The Department is looking for someone to teach undergraduate igneous petrology and perhaps a course in geophysics. The average department course load per quarter is two courses.

The position is replacing a faculty member on sabbatical and therefore is not permanent or on a tenure track. To apply send a resume and two letters of recommendation to: Arnold J. Silverman, Chairman, Department of Geology, University of Montana, Missoula, MT by May 15, 1983.

The University of Montana is an equal opportunity/affirmative action employer.

Graduate Research Assistantships. The Department of Geology at Sul Ross State University anticipates the availability of graduate research assistantships to students interested in the MS program. Research areas will include: mineralogy, petrology and geochemistry of igneous rocks, volcanology, structural geology, planetary geology, geomorphology, carbonate petrology and paleoenvironments. Appointments are half-time with a maximum stipend of $5,000 and waiver of out-of-state tuition.

Applicants should submit a letter of application stating research interests along with a transcript and two letters of recommendation to: Dennis Nielson, Chairman, Geology Department, Sul Ross State University, Alpine, TX 79832.

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

Calderas and Hydrothermal Systems. Held in Yellowstone National Park, August 22–27, 1983. College credit available. For more information, contact: THE YELLOWSTONE INSTITUTE, Box 515, Yellowstone National Park, WY 82190 (406) 443-0861.

AGU

Membership Applications Received

Applications for membership have been received from the following individuals. The letter after the name denotes the proposed primary section affiliation; the letter A denotes the Atmospheric Sciences section, which was formerly the Meteorology section.

Regular Member

Isa Asudeh (S), Bohdan Balko (O), Jeffery F. Billings (H), Joachim Birn (SM), Charles I. Buckley (H), Pius J. Cagienard (S), Charles F. Capen (P), Woncheol C. Cho (H), Arthur G. Crook (H), Andrew G. Fountain (H), Jacqueline I. Gordon (A), Kenneth E. Heikes (A), Joseph C. Ingari (S), H. G. James (SM), F. J. Kelly (O), Sumant Krishnaswamy (SM), Anthony J. Lawrence (H), Thomas Lyttle (V), David R. Lyzenga (O), Albert Matte (O), Charles Obled (H), Mary T. Osborn (A), D. J. Peterson (S), Rajagopal Raghavan (H), Frank M. Richter (T), Jacqueline A. Richter (O), Sheldon Rosell (O), Mark D. Taylor (H), Albert A. Viggiano (A), Christian C. Weber (T), Eliza I. Wojtaszek (T), Rongsheng Zeng.

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Associate Member

A. Badry (H), Tammy King Walsh (O).

Meetings

Program Summary

Union
Satellites & Geosciences, Wed AM
History of Geophysics, Wed AM
Satellites & Geosciences, Wed PM
Test Ban Verification, Thurs AM
Test Ban Verification, Thurs PM

Atmospheric Sciences
Tropospheric Chemistry, Mon PM
El Chichón, Tues AM
Dry Deposition, Tues AM
Stratospheric Chemistry, Tues PM
Ocean/Climate Interactions, Wed PM
New Observing Systems, Thurs AM
Climate Changes, Thurs AM
History of Meteorology, Thurs PM

Geodesy
Earth & Ocean Tides, Tues AM
Results on Earth Rotation, Tues PM
Gravity Analysis I, Wed AM
Crustal Movements I, Thurs AM
Crustal Movements II, Thurs PM
Gravity Analysis II, Fri AM

Geomagnetism & Paleomagnetism
Magsat Studies, Mon AM
Long Wavelength Anomalies, Mon PM
Paleomagnetism—Sediments, Tues AM
Paleomagnetic Results, Tues PM
Reversals & Plate Motion, Wed AM

Hydrology
General Surface Water, Mon AM
Intl. Urban Hydrology I, Mon PM
Urban Runoff I, Tues AM
Intl. Urban Hydrology II, Tues PM
General Hydrology, Wed AM
Urban Runoff II, Wed AM
General Ground Water, Wed PM
Ground Water & Fractures I, Thurs AM
Ground Water & Fractures II, Thurs PM
Evapotranspiration, Fri AM

Oceanography
Absolute SST Measurements, Mon AM
Texas/Louisiana Shelf, Mon AM
SAR & Visible Imagery, Mon PM
Gulf of Maine, Mon PM
Atlantic Variability, Tues AM
STACS, Tues PM
Marine Geology I, Wed AM
Marine Chemistry, Wed PM
Marine Geology II, Wed PM
Tides & Waves, Wed PM
Paleo-oceanography, Thurs AM
Estuarine Geochemistry, Thurs AM
Physical Oceanography, Thurs PM
Trace Elements, Thurs PM
Chemical Fluxes, Fri AM
Ocean Currents, Fri AM

Planetology
Moon & Mars Meteorites I, Mon AM
Moon & Mars Meteorites II, Mon PM
Planetary Exospheres, Tues AM
Surfaces & Geophysics, Tues PM
Planetary Posters, Tues PM

Seismology
Prediction, Mon AM
Crust & Rays, Mon AM
Modes & Surface Waves, Mon PM
Sources & Stress, Tues AM
Ocean Margins, Tues PM
Seismology & Volcanism, Wed AM
Global & Regional Seismicity, Wed PM
Q & Fluid Interaction, Thurs PM
Ocean Surveys & Seismicity, Fri AM

SPR: Aeronomy
Exosphere/Ionosphere, Mon AM
Airglow/Aurora, Mon PM
Thermospheric Dynamics I, Tues AM
Thermospheric Dynamics II, Tues PM
Ionosphere/Airglow, Tues PM
Atmospheric Electricity I, Wed AM
Atmospheric Electricity II, Wed PM
Radar Studies Ionosphere I, Thurs AM
Radar Studies Ionosphere II, Thurs PM
Middle Atmosphere I, Thurs PM
Middle Atmosphere II, Fri AM

SPR: Cosmic Rays
Cosmic Rays in Geophysics, Mon AM
Cosmic Rays in Geophysics, Mon PM
Flares & Cosmic Rays, Tues PM

SPR: Magnetospheric Physics
CDAW-6 Results I, Tues AM
Charged Particles I, Tues AM
Waves & Instabilities, Tues AM

EOS

Transactions, American Geophysical Union

The Weekly Newspaper of Geophysics

For full articles and meeting reports send one copy of the double-spaced manuscript to *Eos* c/o AGU at the address below and three copies to one of the editors, or send all four copies to *Eos*. For news items, send two copies of the double-spaced manuscript to *Eos*.

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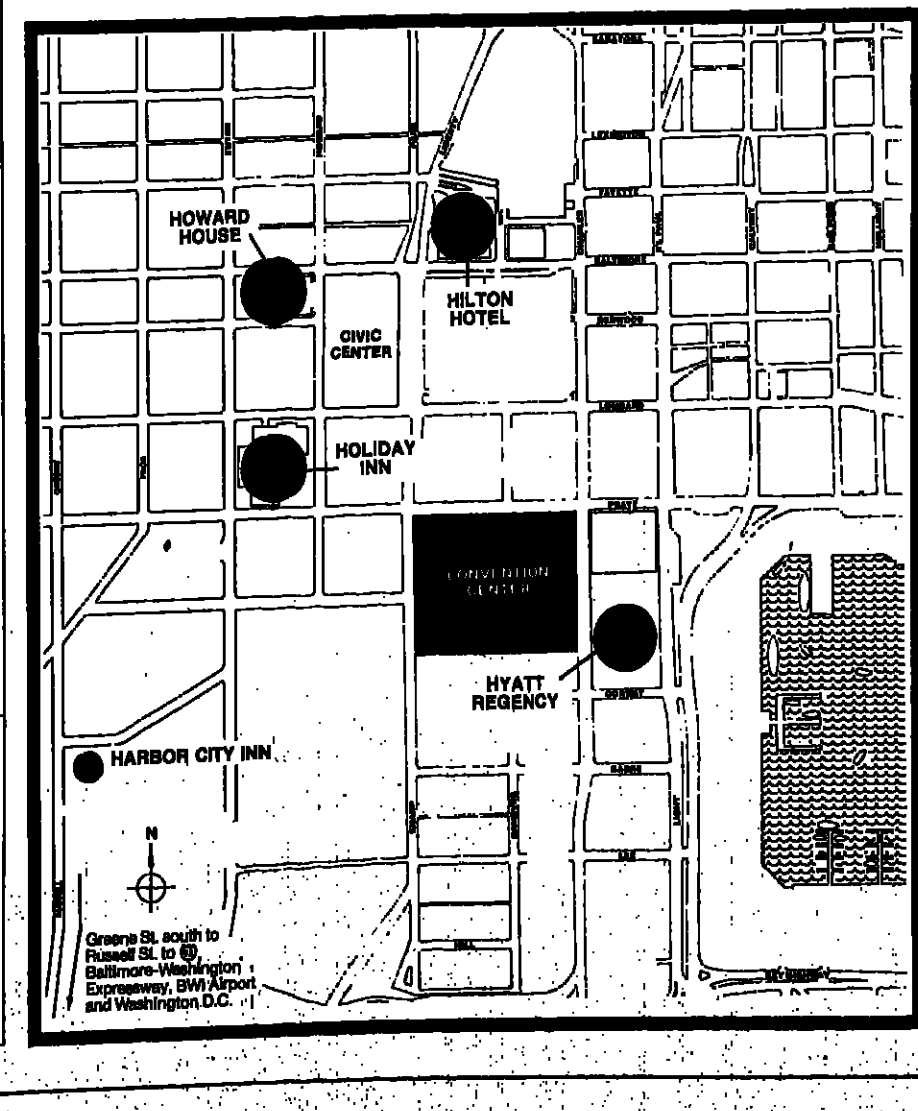
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D. C. 20009

Cover. Sails frame Baltimore's Inner Harbor, where new hotels, shops, and promenades and an architecturally striking new national aquarium form one of the nation's most exciting cityscapes. The Baltimore Convention Center, site of the 1983 AGU Spring Meeting, is two blocks from the Inner Harbor. This issue of *Eos* is the last to contain Housing and Meeting Registration forms for the 1983 Spring Meeting. (Cover design by Patricia Bangert.)



AGU Honors

1983 Medalists and Awardees

Syun-iti Akimoto - Bowie Medal
John W. Handin - Bucher Medal
Fred Noel Spiess - Ewing Medal
S. Keith Runcorn - Fleming Medal
William L. Chameides - Macelwane Award
Donald J. DePaolo - Macelwane Award
Thomas H. Jordan - Macelwane Award
Waldo E. Smith - Waldo E. Smith Award

The 1983 Bucher Medal will be presented to John Handin at the Fall Meeting.

1983 Fellows

Peter L. Bender, Geodesy
Herbert S. Bridge, Solar Planetary Relationships
Marx Brook, Atmospheric Sciences
Harmon Craig, Volcanology, Geochemistry & Petrology
Lynn W. Gelhar, Hydrology
G. V. Gibbs, Volcanology, Geochemistry & Petrology
Dennis E. Hayes, Oceanography
Andrew P. Ingersoll, Planetology
Hugh H. Kieffer, Planetology
Michael W. McElhinny, Geomagnetism & Paleomagnetism
John G. Ramsay, Tectonophysics
Frank M. Richter, Tectonophysics
Jacob Rubin, Hydrology
Edward C. Stone, Solar Planetary Relationships
James R. Wallis, Hydrology

Join in the Festivities

The **Honors Ceremony** will be held in the Francis Scott Key Ballroom of the Baltimore Hilton Hotel at 6:00 P.M. on Wednesday, June 1. All meeting participants are invited and are urged to attend. A **Reception** will follow the ceremony; you can meet and congratulate those being honored and share a glass of sherry with them.

The **President's Dinner** in honor of the medalists, awardees, and Fellows will begin at 8:00 P.M. It is a more lavish and formal affair. Tickets for the dinner are $25 per person. You may order your tickets with your advance registration, purchase them at the meeting, or call AGU toll free at 800-424-2488 (462-6903 in the D.C. area).

Tail & Boundary Layer I, Tues PM
Jupiter & Saturn, Tues PM
Numerical Simulation I, Tues PM
CDAW-6 Results II, Tues PM
Aurora & Substorms I, Tues PM
Currents & Fields, Tues PM
Tail & Boundary Layer II, Wed AM
Frontiers of SPR, Wed PM
Numerical Simulation II, Wed PM
Charged Particles II, Thurs AM
Waves, Currents, E Fields, Thurs AM
Numerical Simulation III, Thurs PM
Aurora & Substorms II, Thurs PM
Lab & Space Experiments, Fri AM
Aurora & Substorms III, Fri AM

SPR: Solar & Interplanetary Physics
Solar Seismology, Mon AM
Corona & Solar Wind, Tues AM
Sunspots & Solar Data, Tues PM
Shocks I, Wed AM
Shocks II, Wed PM
MHD Turbulence in Space, Thurs PM

Tectonophysics
Ridges & Convection, Mon PM
Subduction, Tues AM
Crustal Deformation, Tues AM
Mineral Physics, Tues PM

Ocean Crust, Tues PM
Cracks & Brittle Behavior of Rock, Wed AM
Structural Geology, Wed PM
Continental Crust, Thurs AM
Paleo-oceanography, Thurs AM
Basins & Seismic Reflection, Thurs PM
Ductile Rock Deformation, Thurs PM
Q & Fluid Interaction, Thurs PM
Mantle Heterogeneities, Fri AM

Volcanology, Geochemistry, & Petrology
Andean Magmatism I, Mon AM
Ophiolites & Anorthosites, Mon AM
Andean Magmatism II, Mon PM
Precambrian, Mon PM
Oceanic Basalt, Tues AM
Isotope Geochemistry I, Tues AM
Volcanic Petrology, Tues PM
Isotope Geochemistry II, Tues PM
Xenoliths, Kimberlites, Wed AM
Water in Silicate Melts I, Wed AM
Water in Silicate Melts II (Posters), Wed PM
VGP Posters, Wed PM
Mantle Heterogeneities I, Thurs AM
Experimental Petrology I, Thurs AM
Experimental Petrology II, Thurs PM
Mantle Heterogeneities II, Thurs PM
Metamorphic Petrology, Fri AM
Mineralogy & Crystallography, Fri AM

1983 AGU Spring Meeting: Housing and Registration Forms—Last Printing!

Ahoy! *Sail Back into Baltimore*

for the
1983 AGU
Spring Meeting

May 30–June 3

HOTEL ACCOMMODATIONS

PARTICIPATING HOTELS	HOTEL CODE	ROOM RATES
Hyatt Regency 300 Light Street (301) 528-1234	HRDT	Single: $58.00 Double: $68.00 Twin: $68.00 Extra person: $15.00
Baltimore Hilton 101 W. Fayette Street (301) 752-1100	BHDT	Single: $51.00 Double: $61.00 Twin: $61.00 Extra person: $10.00 Parlor + 1 $150.00 to $190.00 Parlor + 2 $200.00 to $250.00
Holiday Inn - Downtown 301 W. Lombard Street (301) 685-3500	HIDT	Single: $39.00 Double: $47.00 Twin: $55.00 Extra person: $10.00
Howard House Hotel 8 North Howard Street (301) 539-1680	HHDT	Single: $33.00 Double: $38.00 Twin: $42.00 Parlor + 1 $52.00 Extra person: $10.00
Harbor City Inn 1701 Russell Street (301) 727-3400	HCIB	Single: $32.00 Double: $37.00 Twin: $37.00 Extra person: $5.00

PARKING: **Hyatt/$6.00*** **Hilton/$2.60*** **Holiday Inn/free** **Harbor City Inn/free** - (location requires car or bus transportation to Convention Center)

*** Subject to change.**

All hotel reservations must be made on the housing form. Confirmations will be mailed directly to registrants by the individual hotels. After confirmation has been received, changes and cancellations should be made with the hotel directly.

Mail your completed form directly to:
Housing Coordinator
AGU Spring Meeting
Baltimore Housing Bureau
1 East Pratt Street
Baltimore, Maryland 21202

PLEASE RETAIN THIS FORM FOR YOUR RECORDS

American Geophysical Union
SPRING 1983 MEETING
May 30–June 3, 1983
Baltimore, Maryland

Housing Coordinator
AGU Spring Meeting
Baltimore Housing Bureau
1 East Pratt Street
Baltimore, Maryland 21202

HOUSING APPLICATION FORM

READ CAREFULLY:
Please print or type (pica spaced) all information abbreviating as necessary. Confirmation will be sent by the hotel to the individual named in Part I. If more than one room is required, *this form may be photocopied.*

PART I

REQUESTOR
LAST NAME — FIRST
NAME OF COMPANY OR FIRM
STREET ADDRESS OR P.O. BOX NUMBER
CITY — STATE — ZIP U.S.A.
COUNTRY — AREA CODE — PHONE NUMBER

PART II

INSTRUCTIONS: Select *THREE* Hotel/Motels of your choice from the list of participating facilities, then enter the appropriate code letters in the boxes below.

FIRST CHOICE — HOTEL CODE
SECOND CHOICE — HOTEL CODE
THIRD CHOICE — HOTEL CODE

NOTE: Rooms are assigned in "First Come First Serve" order and if none of your choices are available, another facility will be assigned based on a referral system arranged by your convention organizer. A cut-off date is in effect and your application may not be processed if received after 14 days prior to your arrival date.

PART III

INSTRUCTIONS: 1. Select type room desired with arrival and departure dates.
2. *PRINT* or *TYPE* names of *ALL* persons occupying room.
3. If more than two people share a room, check twin and the hotel will assign two double beds.

CHECK ONE		
☐ SINGLE (Room with one bed one person)	Arrival Date ____ MO DAY	Guest Names (Print Last Name First)
☐ DOUBLE (Room with one bed two persons)	Departure Date ____ MO DAY	1.
☐ TWIN (Room with two beds two persons)	Arrival Time ____ AM PM	2.
☐ P + 1 (Parlor plus one-bedroom suite)		3.
☐ P + 2 (Parlor plus two-bedroom suite)		4.
☐ EXTRA PERSON		

IMPORTANT NOTE: Hotel *MAY* require a deposit or some other form of guaranteed arrival. If so, instructions will be on your confirmation form.

RETURN THIS FORM WITH PAYMENT TO:
Meetings Registration
American Geophysical Union
2000 Florida Ave., N.W.
Washington, D.C. 20009

PLEASE PRINT CLEARLY

NAME ON BADGE
AFFILIATION
MAILING ADDRESS ____
Telephone # ____
HOTEL ____

Days you plan to attend.
☐ Monday ☐ Wednesday ☐ *Friday*
☐ Tuesday ☐ Thursday
Please check appropriate box.
Members of the cooperating societies may register at AGU member rates.
Member badges are blue on white.
Nonmember badges are red on white.
☐ Member AGU ☐ Nonmember
☐ Member cooperating society.
AMS-American Meterological Society
ASP-American Society of Photogrammetry
ACSM-American Congress on Surveying and Mapping
UGM-Union Geofisica Mexicana
CGU - Canadian Geophysical Union
EGS - European Geophysical Union

Nonmembers
The difference between member (or student member) registration and nonmember registration may be applied to AGU dues if a completed membership application is received at AGU by *July 25, 1983. Current AGU* annual membership rates are: $20 Members; $7 Student Members.

Preregistrants
Your receipt will be in your preregistration packet. The registration fee will be refunded if written notice of inability to attend is received in the AGU office by May 26. The program and meeting abstracts will appear in the May 3 issue of *EOS*, which is mailed to all members of AGU in advance of the meeting.

Office Use Reference Number

AGU 1983 SPRING MEETING
MAY 30–JUNE 3, 1983
Baltimore, MD.

REGISTRATION FORM
DEADLINE FOR RECEIPT OF PREREGISTRATION
MAY 11, 1983

(rates applicable only if received by May 11, with payment)

	More than one day	One day
MEMBER	☐ $65	☐ $32.50
STUDENT MEMBER	☐ $32	☐ $16
NONMEMBER	☐ $85	☐ $42.50
STUDENT NONMEMBER	☐ $39	☐ $19.50
RETIRED SENIOR MEMBER	☐ $32	☐ $16
ABSTRACTS (May 3, 1983, EOS)	☐ $5	☐ $5
PRESIDENT'S DINNER -Wednesday	☐ $25	☐ $25

SECTION LUNCHEONS

All tickets are $9.50 except for Seismology which is sponsored, cost is $5

☐ Atmospheric Sciences-Thursday
☐ Geodesy-Thursday
☐ Geomagnetism and Paleomagnetism-Wednesday
☐ Hydrology-Wednesday
☐ Oceanography-Tuesday
☐ Planetology/Volcanology, Geochemistry and *Petrology*-Wednesday
☐ Seismology-Wednesday
☐ Tectonophysics-Thursday

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Separates

To Order: The order number can be found at the end of each abstract; use all digits when ordering. Only papers with order numbers *are available from AGU*. *Cost:* $3.50 for the first article and $1.00 for each additional article in the same order. Payment must accompany order. Deposit accounts available.

Copies of English translations of articles from Russian translation journals are available either in unedited form at the time of their listing in EOS or in final printed form when a journal is published. The charge is $2.00 per Russian page.

Send your order to:
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2000 Florida Avenue, N.W.
Washington, D.C. 20009

Aeronomy

0460 Tides, waves and winds
FIFTEEN-DAY OBSERVATION OF MESOSPHERIC AND LOWER THERMOSPHERIC MOTIONS WITH THE AID OF THE ARECIBO UHF RADAR
I. Hirota (Geophysical Institute, Kyoto University, Kyoto 606, Japan), Y. Maekawa, S. Fukao, K. Fukuyama, M. P. Sulzer, J. L. Fellous, T. Tsuda and S. Kato
An attempt was made to have a continuous observation of the zonal wind component in the tropical mesosphere and lower thermosphere for 15 days of August 1 through 15, 1980, with the aid of the UHF radar at Arecibo (18° N). By using the wind data, together with additional data obtained from meteorological rockets, meteor radar and Tiros-N satellite, analyses were made of the time-mean zonal wind profile, tides, long-period waves and short-period gravity-type waves, respectively. There appears a remarkable day-to-day variation of the zonal wind throughout the region between 70 and 95 km with a characteristic time scale of about 5 days, indicating the passage of travelling planetary-scale waves in the summertime tropical middle atmosphere. It was also found that the short-period oscillation with a time scale of a few ten minutes appears intermittently in association with the strong vertical shear of the background flow. This oscillation is considered to be the manifestation of the Kelvin-Helmholtz type instability in the lower thermosphere. (MST radar, mesosphere and lower thermosphere, long-period waves, tides, gravity waves).
J. Geophys. Res., Green, Paper 3C0580

0460 Aeronomy
HIGH-LATITUDE STRATOSPHERIC WINDS NEAR 30 KM: DIURNAL AND SEMIDIURNAL POLAR TIDES
N. D'Angelo (Danish Space Research Institute, Lundtoftevej 7, 2800 Lyngby, Denmark), T. Neubert, I. B. Iversen, and H. H. Madsen
A technique for studying winds and tides, at altitudes of approximately 30 km, is the continuous and precise tracking of zero-pressure, stratospheric balloons. The OMEGA navigation system allows tracking of a balloon over the North Atlantic, for two days or longer. Tidal wind data from 14 balloon trajectories (approximately 670 balloon hours) are presented and compared with theoretical predictions. (Winds, tides).
J. Geophys. Res., Green, Paper 3C0401

Exploration Geophysics

0910 Computer applications
CONTINUOUSLY TIME-VARIABLE RECURSIVE DIGITAL BAND-PASS FILTERS FOR SEISMIC SIGNAL PROCESSING
See 0930 Seismic methods
E. A. Stein (Department of Electrical Engineering, University of Calgary, 2500 University Drive N.W., Calgary, Alta., Canada T2P 1N4) M. B. Bertley
A design technique is described for continuously time-variable recursive digital band-pass filters for seismic signal processing. Two types of band-pass filters are considered: a cascade of a low-pass and a high-pass filter, and a direct band-pass filter, with all filters being derived from a continuous unit-bandwidth Butterworth low-pass prototype. Linear interpolation of the filter coefficients between points at which they are known exactly is used to reduce the computational overhead. Data are given for determining the length of the interpolation interval to meet prescribed worst case magnitude and frequency error criteria. A zero-phase response is achieved by filtering in the forward time direction followed by filtering in the reverse time direction. An example is included.
GEOPHYSICS, VOL. 48, NO. 6

0920 Magnetic and electrical methods
WERNER DECONVOLUTION FOR AUTOMATED MAGNETIC INTERPRETATION AND ITS REFINEMENT USING MARQUARDT'S INVERSE MODELING
Chao C. Ku (Formerly Aero Service Division, Western Geophysical Company of America, Houston, TX; presently Amoco Production, Houston, TX 77001) John A. Sharp
We present a deconvolution for automated magnetic interpretation based on Werner's (1953) simplified thin-dike assumption which leads to the linearization of complex nonlinear magnetic problems. The usefulness of the method is expanded by the fact that the horizontal gradient of the total field caused by the edge of a thick interface body is equivalent to the total field from a thin dike. Statistical decision, numerical iteration, and a seven-point operator are used to improve approximations of susceptibility, dip, depth, and horizontal location of the source. Marquardt's nonlinear least squares method for inverse modeling is then used to refine automatically the first approximation provided by the deconvolution. Synthetic and real total-field data are used to demonstrate the process.
GEOPHYSICS, VOL. 48, NO. 6

0930 Seismic methods
REFLECTION OF SPHERICAL SEISMIC WAVES IN ELASTIC LAYERED MEDIA
Paul H. Krail (Getty Oil Company, Research Center Annex, P.O. Box 42214, Houston, TX 77042) Henry Brysk
The solution of the elastic wave equation for a plane wave incident on a plane interface has been known since the turn of the century. For reflections from reasonably shallow beds, however, it is necessary to treat the incident wave as spherical rather than plane. The formalism for expressing spherical wavefronts as contour integrals over plane waves goes back to Sommerfeld (1909) and Weyl (1919). Brekhovskikh (1960) performed a steepest descent evaluation of the integrals to attain analytic results in the acoustic case. We have extended his approach to elastic waves to obtain spherical-wave Zoeppritz coefficients. We illustrate the impact of the curvature correction *parametrically (as the velocity and density contrasts* and Poisson's ratios are varied). In particular, we examine conditions appropriate to "bright spot" analysis; expectedly, the situation becomes less simple than in the plane-wave limit. The curvature-corrected Zoeppritz coefficients vary more strongly (and in a more complicated manner) with the angle of incidence than do the original ones. The determination of *material properties (velocities and densities) from the* reflection coefficients is feasible in principle, with exacting prestack processing and interpretation. For orientation, we outline the procedure for the simple case of a separated single source and detector pair over a multilayered horizontal earth.
GEOPHYSICS, VOL. 48, NO. 6

0930 Seismic methods
SEISMIC SHEAR-WAVE OBSERVATIONS IN A PHYSICAL MODEL EXPERIMENT
Robert H. Tatham (Petty-Ray Geophysical, P.O. Box 36306, Houston, TX 77036) Donald V. Goolsbee, Wulf F. Massell, and H. Roice Nelson
The observation and common-depth-point (CDP) processing of mode-converted shear waves is demonstrated for real data collected in a physical model experiment. The model, submerged in water, represented water depth scaled to 250 ft, the first subsea reflector at 4000 *ft, and the last reflector at 7000 ft below the sea* floor with a structural wedge at the center. Very efficient mode conversion, from *P* to *SV* and back to *P*, is anticipated for angles of incidence at the liquid-solid interface (sea floor) between 35 to 80 degrees.
The model, constructed of Plexiglas and 3180 resin, will support elastic shear-wave propagation. One anticipated problem, internal reflections from the sides of the model, was solved by tapering the sides of the model to 45 degrees off vertical. The *P* wave reflection coefficient at an interface between Plexiglas and water is 35 percent for vertical incidence, but it diminishes to very nearly zero between 43 and 75 degrees. Thus, by tapering the sides of the model, any undesired internal *P* wave reflections had to undergo at least two reflections at angles of incidence in the low reflection coefficient range for *P* waves.
Data were collected in both an end-on CDP mode, with offsets from 1000 ft to 20,000 ft, and a variety of walk-away experiments with scaled ranges from 1000 ft to 31,000 ft. Processing and analysis of the data confirm the existence of mode-converted shear-wave *reflections in a modeled marine environment.* In particular, the *S* wave reflections from all interfaces are identified on both the 100 percent gathered records and the final stacked records. These *SV* wave reflections were isolated for stacking by considering those portions of the gathered records, both offset and arrival time, that correspond to optimum angles of incidence. In addition, τ-*p* processing isolated particular angles of incidence, further confirming the incidence angle-range criterion. Thus, the desired events are unambiguously identified as mode-converted shear waves.
GEOPHYSICS, VOL. 48, NO. 6

0999 General or miscellaneous
COMPOSITE COLOR IMAGES OF AERIAL GAMMA-RAY SPECTROMETRIC DATA
Joseph S. Duval (U.S. Geological Survey, Box 25046, MS 964, Denver Federal Center, Denver, CO 80225)
Aerial gamma-ray data provide estimates of the apparent surface concentrations of potassium (K), *equivalent uranium (eU), and equivalent thorium (eTh).* These data can be expressed as nine radiometric parameters: K, eU, eTh, eU/eTh, eU/K, eTh/K, eTh/eU, K/eU, and K/eTh. The U.S. Geological Survey (USGS) has developed a technique which combines any three of these parameters to form a composite color image. The color image provides a partial synthesis of the radiometric data that can be used to aid geologic mapping and mineral exploration. The sample data set, from the Freer area in south Texas, illustrates the use of the color images.
GEOPHYSICS, VOL. 48, NO. 6

Geodesy and Gravity

1935 Low-order harmonics of the gravity potential field
THE ACCURACY OF THE LOW DEGREE GEOPOTENTIAL: IMPLICATIONS FOR OCEAN DYNAMICS
C. A. Wagner (National Geodetic Survey, National Ocean Service, NOAA, Rockville, Maryland 20852)
The low-degree portion of a number of recent global gravitational fields have been tested for accuracy using precise accelerations measured on 24-hour satellites. These measurements are independent of the data in the field models. The results show that the most accurate of the recent solutions have degree error variances significantly less than 10 cm (geoid height equivalent) for all degrees less than five. The broad and lasting features of ocean circulation should now be visible when comparing the geoid computed from this model with the average sea surface computed from satellite altimetry. However, before accurate mapping is possible, the equivalent accuracy of the mean altimetric *surface at long wavelengths needs to be verified.*
J. Geophys. Res., Red, Paper 3B0414

1999 General or miscellaneous
COMPACT GRAVITY INVERSION
B. J. Last (Formerly International Institute for Aerial Survey and Earth Sciences (ITC), Delft, The Netherlands; presently Watts, Griffis and McOuat (Saudi Arabia) Ltd., P.O. Box 5219, Jeddah 21422, Saudi Arabia) K. Kubik
We present a new criterion for the inversion of gravity data. The principle employed is to minimize the volume of the causative body, which is equivalent to maximizing its compactness. The anomalous density *distribution is obtained using an iterative technique* which is numerically stable and rapidly convergent. The principle can also be adapted to include modeling of gravity anomalies by single-density sources.
The advantage of this approach is that desirable geologic characteristics are automatically incorporated into the model with a minimum of subjective judgments on the part of the interpreter.
The treatment of noise in the data *fits naturally* into the formulation of the inversion procedure.
The method is illustrated by the inversion of noise-free and noisy data generated from a two-dimensional model consisting of a regular array of identical rectangular blocks whose densities can be individually specified. In every case the algorithm successfully recovers the correct density distribution from the data. In the case of noise-contaminated data, a complete separation of the noise from the signal is achieved.
The practical effectiveness of the method is demonstrated by the inversion of published gravity data. The results obtained are compared with existing models and with available drilling information.
GEOPHYSICS, VOL. 48, NO. 6

Physics of the Solid Earth
Volume 18, Number 7

Physics of the Solid Earth
Volume 18, Number 8

Hydrology

3125 Glaciology
THE RESPONSE OF ANTARCTIC ICEBERGS TO OCEAN WAVES
Peter Wadhams, Monica Kristensen (Scott Polar Research Institute, University of Cambridge, Cambridge CB2 1ER, England) and Olav Orheim (Norsk Polarinstitutt, PO Box 158, 1330 Oslo Lufthavn, Norway).
The heave, tilt and strain responses of three Antarctic tabular icebergs to ocean waves were measured during a 1980-1 cruise of HMS "Endurance" to the South Atlantic. The three icebergs, located near the South Sandwich and South Orkney Islands, were instrumented with accelerometers, tiltmeters and wire strainmeters, while a Waverider buoy was used to record the ocean wave field. The thickness of the icebergs was surveyed by a helicopter-borne radio echo sounder. The heave response occurred mainly at the swell period, but with outbreaks of bobbing which lasted for a few cycles at a resonant period (about 40s) which agreed well with the predictions of a numerical finite element model. The roll response occurred mainly at a long resonant period (40-50 s) which again agreed well with the model, but there was also a significant response at ocean wave periods (5-20 s) which exceeded predictions. The strain response had a component at very long periods which is unexplained by theory, while the surface strain at ocean wave periods agreed with the simple analytical model of Goodman et al (1980). Using this model it is possible to predict a wave height and period that will cause breakup of the icebergs, and we conclude that swell-induced breakup is likely to occur during major storms in the open Southern Ocean. (Icebergs, ocean waves, Southern Ocean, floating bodies).
J. Geophys. Res., Green, Paper 3C0570

3170 Snow and Ice
SOME METEOROLOGICAL APPLICATIONS OF RADIOACTIVE FALLOUT MEASUREMENTS IN ANTARCTIC SNOWS
M. Pourchet (Laboratoire de Glaciologie et Géophysique de l'Environnement-CNRS, 2, rue Très-Cloîtres, 38031 Grenoble-Cedex), F. Pinglot and C. Lorius
Radioactive fallout, generally performed to determine average snow accumulation rates, can also be used to determine other meteorological information. The following results were obtained from measurements on the Antarctic ice sheet:
a) a stratospheric residence time of 1.5 years for radioisotopes such as 90Sr and 137 Cs.
b) a value of approximately 1 for the ratio φ between the concentration measured in the air (g/s.c.m) and the concentration determined in the snow (g/g), with extreme values of 0.5 and 5.
c) the dry fallout represents between 15 and 25 % of the total deposition in the coastal regions and as much as 40 to 60 % in the central zones.
d) a precipitation increase of 30 % occured after 1965 when compared with the decade 1955-1965.
J. Geophys. Res., Green, Paper 3C0569

Meteorology

3720 Climatology
HIMALAYAN WINTER SNOW COVER AREA AND SUMMER MONSOON RAINFALL OVER INDIA
M. Dey and O.S.R.U. Bhanu Kumar (Department of Geology and Geography, Howard University, Washington, D. C. 20059).
The study presented in this paper examines the relationship between satellite derived Himalayan snow cover extent in winter season (December to March) and the amount of summer monsoon rainfall for the period 1971 to 1980. Himalayan snow cover area has been derived from satellite images and northern hemisphere snow cover charts produced by the NOAA-NESS. Indian summer monsoon rainfall was the area-weighted mean of all meteorological subdivisions of India for the months June through September. The variations of Indian summer monsoon rainfall were compared with that of the Himalayan winter snow cover area. There is an inverse relationship (negative correlation) between these two variables which indicate that more than mean Himalayan winter snow cover area is to be followed by less than normal (IMD) summer monsoon rainfall over India. The inverse relationship holds true for eight out of ten years study period. The coefficients of correlation between the Himalayan snow cover area departures from ten-year mean and the rainfall departures from IMD normals for all the selected meteorological subdivisions of India were computed. The resulting correlations were found to be maximum in the region between 10°N latitude and the foothills of the Himalayas.
J. Geophys. Res., Green, Paper 3C0559

3770 Particles and Aerosols
RADIATIVE PROPERTIES OF THE STRATOSPHERIC DUST CLOUD FROM THE 18 MAY 1980 ERUPTION OF MT. ST. HELENS
J. J. DeLuisi, B. G. Mendonca, and E. G. Dutton, (NOAA/ERL/ARL, Boulder, Colorado, 80303), M. A. Box and B. M. Herman, University of Arizona, Tucson, AZ 85721)
Measurements of the 2π steradian (hemispheric) diffuse sky, direct, and total (diffuse and direct) transmitted solar flux were made at Boulder, Colo., during the passage of the Mount St. Helens dust cloud on May 19 and June 3, 1980. The measurements were both narrowband and broadband integrated over the solar spectrum. Verification of the presence of the cloud and its vertical profile was obtained by Lidar. Analysis of the flux measurements by a perturbation technique yielded volcanic cloud optical properties useful for studies of climate variation. The ratio of backscatter to total scatter, imaginary term of the complex refractive index, albedo of single scatter, and optical depth are determined from the measurements. Estimates of solar radiation absorption and backward and forward scattering by the cloud are given. Certain radiative characteristics of the Agung volcanic cloud and the Mount St. Helens volcanic cloud are compared.
J. Geophys. Res., Green, Paper 3C0558

3799 General (Ozone Transport)
A MECHANISTIC MODEL OF EULERIAN, LAGRANGIAN-MEAN, AND LAGRANGIAN OZONE TRANSPORT BY STEADY PLANETARY WAVES
Richard B. Rood (NASA/Goddard Space Flight Center, Code 964, Greenbelt, MD 20771) and Mark R. Schoeberl
Ozone transport is calculated for steady, dissipative planetary waves using the Eulerian, Lagrangian-mean, and residual circulation. A Lagrangian model of parcel dynamics is used to interpret planetary wave-photochemistry interaction. In chemically active regions the mean field ozone changes are found to be significant only where there are large gradients in chemical sources and sinks along parcel trajectories. The largest changes in the mean field are found in the lower stratosphere and are due to the Lagrangian-mean advection. When the Lagrangian-mean advection is approximated by the residual circulation, errors in the transport velocities as large as 30% may occur.
J. Geophys. Res., Green, Paper 3C0447

Particles and Fields— Ionosphere

5515 Auroras
THE EXTREME ULTRAVIOLET SPECTRUM OF DAYSIDE AND NIGHT-SIDE AURORAE: 800-1400 Å
F. Paresce, S. Chakrabarti, S. Bowyer and R. Kimble (Space Sciences Laboratory, University of California, Berkeley, California 94720).
Satellite observations of the auroral emission spectrum between 800 and 1400 Å at 8 Å resolution are presented. The spectrum is dominated by lines of neutral and by N_2 Birge-Hopfield and Lyman-Birge-Hopfield band emission. A number of bright lines, most notably the O II, 834, and the O I, 989 and 1304 Å features, are detectable at all zenith angles sampled by the spectrometer (30-150°). The day auroral spectrum is dominated by atomic oxygen and nitrogen line emissions. The H I, 1216 Å Lyman alpha line is a prominent feature of many of the night and day auroral events.
J. Geophys. Res., Blue, Paper 2A1932

5520 Electric Fields
A FIRST COMPARISON OF STARE AND EISCAT ELECTRON DRIFT VELOCITY MEASUREMENTS
E. Nielsen (Max-Planck-Institut für Aeronomie, 3411 Katlenburg-Lindau, FRG), K. Schlegel
The Scandinavian twin auroral radar experiment (Stare) has a demonstrated capability of providing estimates of the ionospheric electron drift velocities, which are useful for a wide range of geophysical studies. The accuracy of such estimates has for the first time been tested by comparison with simultaneous velocity measurements made with the European incoherent scatter facility (Eiscat). The magnitudes of the estimated drift velocities are in agreement with the Eiscat measurements for small velocities ($< 700\ ms^{-1}$), but we find the estimates to be increasingly too low as the velocities become larger. The directions of the estimated vectors are in agreement with the Eiscat measurements, for all drift magnitudes. The measured phase velocities are even lower than those predicted by the kinetic theory of the two stream instability. Agreement can only be obtained for relatively large neutral densities. The data are not inconsistent with an assumption that the possible phase velocities in the plasma are limited upward by the ion-acoustic velocity (which is an increasing function of the ionospheric electric field). Power spectral observations and an improved modelling with the kinetic theory suggest that a backscatter region, extended in altitude and allowing several values of k, to influence observations, leads to an improved theoretical fit to the measurements. (Plasma convection, wave propagation, instruments and techniques)
J. Geophys. Res., Blue, Paper 3A0565

5545 Ionospheric disturbances
THE MORPHOLOGY OF A MULTI-BUBBLE SYSTEM IN THE IONOSPHERE
J. Chen, P. Satyanarayana, and S.L. Ossakow (Plasma Physics Division, Code 4780, Naval Research Laboratory, Washington, D.C. 20375)
A multi-bubble model is developed to study the morphology of a finite array of plasma density depletions (bubbles) in the context of equatorial F-region irregularities during spread F. The Pedersen current conservation equation with quasi-neutrality is solved analytically using an electrostatic analogy. The solution is exact with no a priori assumption regarding the separation distance. A two-bubble system with a piecewise constant density profile is first analyzed and the technique is then applied to multi-bubble systems to calculate the polarization electric field and the rise velocities. It is shown that the influence of the neighboring bubbles is relatively short-ranged and that a small number of bubbles can adequately model the essential physics in a large array of bubbles. For moderately short separation distances, it is found that the E x B rise velocity is substantially reduced in comparison with the single-bubble case and that the rise velocity is strongly sheared resulting in the deformation of the contours. It is found that these results compare favorably with observational evidence. The implications of the new morphological results on the stability and dynamical behavior of the bubbles are discussed. The theory is also applied to multi-plasma density enhancements such as one might encounter in plasma cloud striation fingers.
J. Geophys. Res., Blue, Paper 3A0571

5580 (Wave Propagation)
CONJUGATE OBSERVATIONS OF PC5 ELECTRIC FIELD WITH A GEOSTATIONARY SATELLITE AND A GROUND RADAR FACILITY
R. Grard (Space Science Department of ESA/ESTEC, Keplerlaan 1, 2201 AZ Noordwijk, The Netherlands) and J.P. Villain.
Pulsating electric fields in the PC5 frequency range have been recorded on 20 November 1979 at 01.30 UT in the magnetosphere and in the ionosphere at magnetically conjugate location. This investigation has been conducted with the satellite GEOS-2 in the vicinity of the geomagnetic equator and the STARE backscatter radar facility located in Northern Scandinavia. Such simultaneous electric field measurements are understood in the light of the field line resonance theory. The profile of the resonant region is described; the polarization of the pulsating fields is defined and the harmonic index of the standing wave is identified. The phase difference between the magnetospheric and ionospheric signals allows the identification of the spacecraft invariant magnetic latitude. (Pulsations, electric fields, field line resonance, conjugate measurements).
J. Geophys. Res., Blue, Paper 3A0572

5580 Wave propagation
IONOSPHERIC SCINTILLATIONS
D. M. Wu and N. Marcuvitz (Microwave Research Institute, Polytechnic Institute of New York, Farmingdale, New York 11735)
A renormalization technique, employed in the spirit of the formal theory of scattering, is applied to the problem of ionospheric scintillations. In the forward scattering limit, using a Markov approximation for ionospheric fluctuations and renormalized moment equations, one derives the wave statistics for a plane wave or beam propagating through the ionosphere. Fluctuations in the latter are described by an arbitrary power spectrum. Peaks superposed on a power law spectrum are found to increase the scintillation index S_4 and a focusing effect is observed in the strong scintillation limit. An experimental power spectrum, obtained from in situ measurements by the Explorer -E satellite and corresponding to electron density fluctuations of 20%, is used to calculate S_4 for night time equatorial scintillations. For an ionospheric slab model 200 km thick at an altitude of 300 km numerical calculations yield an S_4 of about 1.1, in approximate agreement with measurements of Basu.
Rad. Sci., Paper 3S0408

5985 X Rays, Gamma Rays, and Cosmic Rays
NEUTRON HIGH ENERGY SPECTRA AT SEVEN DIFFERENT DEPTHS IN THE ATMOSPHERE FROM 0 TO 40 MBAR NEAR THE GEOMAGNETIC EQUATOR.
V.L. BHATT (Physical Research Laboratory, Ahmedabad 380 009/India).
Atmospheric neutrons 8 to 200 MeV are studied. Neutron differential energy spectra and integrated spectra at 0, 4, 6, 10, and 40 mbar are given. Spectra for E > 50 MeV are given for 7 different altitudes. All spectra show maxima near 40 MeV and large drops near 22 and 100 MeV confirming clear structures. Our results at λ = 7.6°N are compared with others near λ = 42°N both theoretical and experimental. Explanations are offered for the important features and the actual shape of the neutron energy spectra.(Atmospheric neutron energy spectra).
J. Geophys. Res., Blue, Paper 2A1838

5590 Instruments and Techniques
FIRST BISTATIC OBLIQUE-INCIDENCE IONOGRAMS BETWEEN DIGITAL IONOSONDES
J.W. Wright (Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, Colorado 8030), R.I. Kressman
Identical digital ionosondes (dynasondes) at Brighton Colorado and at White Sands Missile Range, New Mexico, 864 km distant, were synchronized for bistatic sounding in multifrequency and fixed frequency recording patterns. Three propagation modes are observed, identified, and reconciled with standard propagation theory: these include one-hop propagation by sporadic e (Es) and the F region, and two-hop (F - Es). Echo phase measurements at the four spaced antennas of the dynasonde receiving array permit echolocation calculations which are in good agreement with the path mid point, although effects of ionospheric tilts and time variations are evident. These results encourage the concept of a global real time ionospheric monitoring network consisting of about ninety instruments which perform vertical incident and coordinated bistatic soundings, to yield a total of about 320 measurement "locations."
Rad. Sci., Paper 3S0549

Particles and Fields— Magnetosphere

5705 Bow shock waves
ENERGETIC IONS UPSTREAM OF THE EARTH'S BOW SHOCK DURING AN ENERGETIC STORM PARTICLE EVENT
M. Scholer (Max-Planck-Institut für extraterrestrische Physik, 8046 Garching, F.R.G.), F.M. Ipavich
We present simultaneous observations of low energy protons and alpha particles from ISEE-3 far upstream and from ISEE-1 close to the earth's bow shock during the passage of an interplanetary shock wave with its associated energetic storm particles. Intensities, spectra and anisotropies of the energetic storm particles are modified due to the interaction of these particles with the earth's bow shock. An intensity spike observed at ISEE-1 during the passage of the interplanetary shock is interpreted as being due to post-acceleration of energetic storm particles at the bow shock by the first order Fermi mechanism. The spikes observed at ISEE-1 after the passage of the interplanetary shock are most probably due to reflection of the energetic storm particles at the bow shock. (Energetic storm particles, reflection, acceleration).
J. Geophys. Res., Blue, Paper 3A0477

5705 Bow Shock Waves (Jovian)
TURBULENCE ANALYSIS OF THE JOVIAN UPSTREAM WAVE PHENOMENON
C. W. Smith (Space Science Center, DeMeritt Hall, University of New Hampshire, Durham, NH 03824), M. L. Goldstein and W. H. Matthaeus
As Voyager 2 approached Jupiter's bow shock, large amplitude fluctuations were seen in both the magnetic field and plasma fluid velocity. These fluctuations generally coincided with the occurrence of long-lived energetic particle events similar to the upstream waves often observed near the earth's bow shock. In this paper we present an analysis of the magnetic field and plasma observations using spectral methods. The characteristic spectral features related to the upstream waves are generally seen near one millihertz. The measured correlation lengths of these fluctuations suggest that they are coherent over only a few wavelengths. Our analysis is consistent with the hypothesis that these fluctuations are driven by streaming ions, possibly protons. No evidence for the existence of whistler waves is found. We argue that some of the observed spectral features suggest that dynamical turbulent processes are occurring in the upstream wave region, including a possible observation of an inverse cascade of magnetic helicity to large spatial scales. (Upstream waves, MHD turbulence).
J. Geophys. Res., Blue, Paper 3A0478

5735 Plasma Instabilities
AN ALTERNATIVE INTERPRETATION OF ION RING DISTRIBUTIONS OBSERVED BY THE S3-3 SATELLITE
D. J. Gorney (Space Sciences Laboratory, The Aerospace Corporation, P. O. Box 92957, Los Angeles, CA 90009)
Recently, theoretical interest has grown in possible plasma wave instabilities arising from free energy in auroral ion distributions, and a number of ion-mode instabilities have been identified. These instabilities typically rely on positive slopes in the ion's velocity distribution either parallel ($\partial f/\partial v_\parallel > 0$) or perpendicular ($\partial f/\partial v_\perp > 0$) to the magnetic field. Upflowing ion beams generated by electrical potential drops along auroral field lines are obvious candidates for the parallel (beam) instability, while ion conics have been treated in the limit of the flute mode ($k_\parallel = 0$) instability, assuming that a positive perpendicular gradient exists in the ion conic distributions. Using data first presented in a theoretical treatment of instabilities arising from ion rings in velocity space (Cattell and Hudson, 1982) it can be shown that ion conics are not responsible for the condition $\partial f/\partial v_\perp > 0$. On the other hand, downflowing ion beam distributions sometimes associated with ion conics can satisfy the condition $\partial f/\partial v_\perp > 0$ and therefore might lead to flute mode instability. Examples of ion conics, downflowing ion beams, and both conics and downflowing beams together are presented in this paper, showing that only the downflowing component leads to significant $\partial f/\partial v_\perp > 0$, while ion conics generally have $\partial f/\partial v_\perp < 0$ and are themselves stable to the flute mode.
Geophys. Res. Lett., Paper 3L0544

5770 Short period (less than 1 day) variations of magnetic field
STARE RADAR OBSERVATIONS OF A PG PULSATION
L.H. Poulter and W. Allan (Physics and Engineering Laboratory, DSIR, Lower Hutt, New Zealand), E. Nielsen and K.-H. Glassmeier
STARE radar observations of a Pg pulsation are used to study the spatial variation of the hydromagnetic wave electric fields in the ionosphere. Both the north-south and east-west electric fields appear to exhibit resonant behaviour. The oscillation is confined to approximately 2° of latitude and both components have similar amplitude maxima of order 40 mV m^{-1}. The longitudinal phase variations yield an azimuthal wave number m~17 and the corresponding ionospheric phase velocity is ~ 9 km s^{-1} westward. Although apparently resonant, the magnitude of the east-west electric field is considerably larger than for previously reported resonant Pc5's thought to originate in the Kelvin-Helmholtz instability on the magnetopause. It is suggested that the Pg may be an even mode oscillation generated by a bounce resonance instability. (Pg pulsation, auroral radar).
J. Geophys. Res., Blue, Paper 3A0465

5775 Trapped Particles
THE FLUX AND SOURCE OF ENERGETIC PROTONS IN SATURN'S INNER MAGNETOSPHERE
A.W. Schardt (Laboratory for High Energy Astrophysics, NASA/Goddard Space Flight Center, Greenbelt, MD 20771) and F.B. McDonald
The flux of energetic protons in Saturn's inner magnetosphere was observed in two channels from 40-63 and 63-160 MeV. Absorption features due to the G ring and the satellites Enceladus and Mimas were easily identifiable. The flux observed in the absorption slot of Mimas can be maintained by the decay of a cosmic ray albedo neutron flux of $7 \times 10^{-3}\ cm^{-2}s^{-1}sr^{-1}$. This flux is entirely consistent with calculations of the neutron flux produced by galactic cosmic ray interactions with the rings of Saturn. The omnidirectional proton flux of $8.2 \times 10^3\ cm^{-2}s^{-1}$ at 2.73 R_s requires a residence time of 30 years. Both the residence time and the energy spectrum are comparable to those found in the inner radiation belt of the Earth. The angular distribution is nearly isotropic in the Mimas slot and beyond $4R_s$. Otherwise the pitch angle distribution is pancake and has been approximated by $\sin^n\alpha$ with n in the range 2-7. This distribution is consistent with an isotropic neutron source in the ring plane. (Magnetosphere, Saturn, Inner Radiation Belt, Satellite Particle Absorption).
J. Geophys. Res., Blue, Paper 3A0466

5799 General
PARADIGM TRANSITION IN COSMIC PLASMA PHYSICS
H. Alfven (Electrical Engineering & Computer Sciences Department, University of California, San Diego, La Jolla, CA 92093
During the 1970's in situ measurements in the magnetospheres, including the solar wind region ("solar magnetosphere") drastically changed our understanding of the properties of cosmic plasmas. Further, we have learned how to generalize results from plasma investigations in one region to other regions. This means that laboratory investigations of plasmas of the size of, say, 10 cm can be used to achieve better understanding of cosmic plasmas of magnetospheric dimensions; say, 10^{10} cm. By another step of 10^9 we can transfer laboratory and magnetospheric results to galactic plasmas of, say, 10^{19} cm. A third jump of 10^9 brings us up to the Hubble distance 10^{28} cm and hence to cosmological problems.
Geophys. Res. Lett., Paper 3L0472

5799 General
ON THE STRUCTURE OF THE MAGNETIC SLOW SWITCH-OFF SHOCK
D. W. Swift (Geophysical Institute, University of Alaska, Fairbanks, Alaska, 99701)
A particle code is used to simulate the evolution of a magnetic slow shock. The initial state is two uniform plasmas related by the Rankine-Hugoniot jump conditions and separated by a transition layer a few ion gyroradii thick. The code follows the evolution of the system in time. Two principal features of the results are the upstream escape of the hot shocked plasma and a damped, left-handed circularly polarized wave on the trailing edge of the shock. Analysis of the trailing wave train indicates that ion cyclotron interaction is important in heating the plasma. The upstream escape of particles results in a temporal broadening of the shock profile. The implications of the simulation results in magnetic merging processes in the neighborhood of an x-type neutral point are described.
J. Geophys. Res., Blue, Paper 3A0523

5799 General (Spacecraft Charging)
OBSERVATIONS OF CHARGING DYNAMICS
R. C. Olsen (Physics Department, University of Alabama in Huntsville, Huntsville, Alabama 35899), C. K. Purvis
Plasma data from the UCSD Auroral Particles Experiments on Applied Technology Satellites 5 and 6 are used to investigate the dynamics of natural charging events. Both eclipse and daylight charging events are considered, and typical responses illustrated by data from specific events. Two different physical processes are found to be involved in the charging process. One of these is straightforward: the spacecraft structure potential responds rapidly to changes in the environment, typically changing by hundreds of volts in a few seconds. The other process is more subtle: differential charging and potential barrier formation precede structural charging and determine the time scale, typically tens of minutes are required for the potential to change by several hundreds of volts. The latter process is found to be predominately responsible for daylight charging on both spacecraft.
J. Geophys. Res., Blue, Paper 3A0578

Planetology

6510 Atmospheres of Planets
VOYAGER 2 PHOTOPOLARIMETER OBSERVATIONS OF TITAN
R.A. West (Laboratory for Atmospheric and Space Physics, University of Colorado, Campus Box 392, Boulder, CO 80309), A.L. Lane, H. Hart, K.E. Simmons, C.W. Hord, D.L. Coffeen, L.W. Esposito, M. Sato and R.B. Pomphrey
Observations of Titan's whole disk polarization at 2640 and 7500 A are presented and analyzed in terms of model scattering atmospheres. If the Titan aerosols are spherical or nearly spherical, no single combination of refractive index and size distribution is able to fit data at both wavelengths. However, a vertically inhomogeneous distribution suggested by Tomasko and Smith, characterized by a size gradient with altitude, fits the data at 2640 A moderately well, but must be modified at intermediate and large optical depths to fit the 7500 A data. Results for synthetic phase functions indicate that the single scattering polarization must be 70% or larger in the uv, and 70% or larger in the near-ir at 90° phase angle, depending on the phase function. If the correct phase function is similar to that for 0.6 μm radius spheres, the uv single scattered polarization must be 84%, and the near-ir single scattered polarization must be over 90%. Such large polarizations are impossible for μm radius spheres, but may be possible for nonspherical particles with effective radii near 0.6 μm, although the existence of nonspherical particles with the other scattering properties required by these and other observations has not been demonstrated.
J. Geophys. Res., Green, Paper 3C0560

6510 Atmospheres of Planets
PHOTOMETRY AND POLARIMETRY OF SATURN AT 2640 AND 7500 A
R.A. West (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309), M. Sato, H. Hart, A.L. Lane, C.W. Hord, K.E. Simmons, L.W. Esposito, D.L. Coffeen and R.B. Pomphrey
We have reduced and tabulated photometry and polarimetry data at 2640 and 7500 A observed by the Voyager 2 photopolarimeter experiment. Spatially resolved limb-to-terminator scans across Saturn's Equatorial Zone from 12° to 68° phase angle provide information on the altitude distribution of uv absorbing hazes, and the phase function and polarizing properties of stratospheric and tropospheric aerosols. Limb-to-terminator scans across the northern hemisphere at 10° phase angle are used to study altitude variations of the tropospheric cloud at several latitudes.
For the Equatorial Zone we find (1) the uv photometry and polarimetry are best fit by Rayleigh's phase matrix; (2) a stratospheric haze of small particles is allowed as long as the optical depth is near unity or less, and the center of the haze layer is in the 30 to 70 mbar region. A diffuse haze fits better than a thin layer, and the aerosol/gas mixing ratio diminishes above 10 mbar. The vertical distribution and optical depth of the haze differ significantly from models proposed by others. To be in agreement with ground based and other spacecraft data, the haze optical depth is about 0.4 at 2640A and decreases by a factor of 10 or more at 6400A. If the haze aerosol scattering properties are similar to those for spheres with mean radius 0.1 μm, their imaginary refractive index is 0.4 or larger at 2640A and the total column density above the tropopause is $10^7\ cm^{-2}$; (3) uv contrasts between belts and zones are interpreted as altitude variations in the top of the tropospheric cloud. The altitudes derived here for 3 latitudes agree with altitudes derived from ground based methane band studies and analyses of polarization from Pioneer 11. A high altitude absorber is abundant in the polar regions; (4) At 7500A, the phase function of tropospheric aerosols in the Equatorial Zone is described by a synthetic two term Henyey-Greenstein function with $g_1 = 0.64 \pm 0.11$, $g_2 = -0.47 \pm 0.06$, $f = 0.87 \pm 0.03$ and $\tilde\omega = 0.986$. The single scattering albedo in the North Equatorial Belt is $\tilde\omega = 0.967$. The Equatorial Zone tropospheric aerosols are positively polarizing at all the phase angles of our observations.
J. Geophys. Res., Green, Paper 3C0547

6599 General (Planetary Rings)
LORENTZ FORCES ON THE DUST IN JUPITER'S RING
G. J. Consolmagno (Department of Earth and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139)
A numerical integration program was developed to follow the paths of dust particles in the Jovian ring, including the acceleration due to gravity, and the Lorentz and drag accelerations arising from the motions of the charged dust through the Jovian plasma. Particles were assumed to start from circular, non-inclined Keplerian orbits. The orbit of a 2.5 micron radius, spherical dust particle of density 2 g/cm³ charged to -10V will become significantly perturbed. The ring will tend to warp northwards near 130-160° longitude (where the longitudinal component of the Jovian magnetic field is strongest); the maximum excursion of these Jupiter ring grains is about 0.1 degrees, consistent with a distance of 220 km above the equatorial plane. This distance is more than an order of magnitude larger than the observed upper limit to the half-thickness of the ring. Either the particles are larger, or the voltages on them less, than what has been inferred by previous workers. The plasma near the ring may be considerably cooler than was estimated. Particles of 0.3 microns with -10V potentials, starting as before in circular orbits near the outer edge of the ring (1.78 R_J), are spread from 1.68 to 1.98 R_J and inclined up to 7 degrees out of the equatorial plane. Their paths do not follow Keplerian orbits, and particle positions are not symmetric about the equatorial plane. Particles of 0.4 micron radius show much less asymmetry in their orbits than the 0.3 micron particles, while particles of 0.2 microns or less are perturbed into the Jupiter cloudtops within a few tens of hours. (Rings, Jupiter magnetosphere, dust).
J. Geophys. Res., Blue, Paper 3A0487

Seismology

6940 Phenomena related to earthquake prediction
PRECISE MEASUREMENT OF SEISMIC TRAVELTIMES - INVESTIGATION OF VARIATION FROM TIDAL STRESS IN SHALLOW CRUST
K.-F. Liu (U.S. Geological Survey, Menlo Park, California, 94025), R. E. Westerlund and J. B. Fletcher
We have conducted 8 precise seismic surveys near Hollister, CA, over a period of 1 y in an attempt to detect the traveltime variation caused by the solid-earth tidal stress. The surveys were conducted along a 600 m baseline located in quartz monzonite hills 2 km west of the San Andreas fault. A 656 cm³ air gun fired in a mud-filled pit 2 m deep provided a repeatable seismic source. The signals from two 2.3 Hz vertical-component geophones 600 m apart were digitized at a nominal rate of 600 samples/s by two cassette recorders modified for precise synchronization of data sampling against a master clock. Each survey consists of ~100 traveltime measurements over the 12 h period between 6 p.m. and 6 a.m. local time; the time frame of each experiment was limited by daytime cultural noises. Analysis of traveltime variation is done either by timing of amplitude extrema or by cross-correlation of a waveform constructed from the digital data by a cubic-spline interpolation. Fractional error of the repeatability of traveltime measurement is typically $\pm 3.3 \times 10^{-4}$ for the first high-frequency, large-amplitude arrival following the direct body waves. The first survey, conducted at a spring tide in August, 1981, showed a variation of $\Delta t/t \sim 2 \times 10^{-3}$ and correlated in time with the extensional tidal strain component along the baseline direction. The next two surveys, conducted at two neap tides, showed variation of $\Delta t/t \sim 6 \times 10^{-4}$ and also correlated with the same tidal strain component. However, the other 5 surveys conducted after the onset of 1981 rainy season and into the 1982 dry season, 4 at spring tides and 1 between a spring and a neap tide, showed traveltime constant to within 1 standard deviation. These results corroborate only partially the previously reported tidal stress variation of traveltimes in the shallow crust. (Seismic traveltime, tidal variation).
Geophys. Res. Lett., Paper 3L0496

6990 Instruments and techniques
TELESEISMIC DETECTION IN THE ALEUTIAN ISLAND ARC
R.E. Habermann (Cooperative Institute for Research in Environmental Sciences, Box 449, University of Colorado, Boulder, CO 80309)
Recently it has become apparent that teleseismic detection has decreased substantially in many regions of the world. The major decrease was related to the closure of the VELA arrays in the United States during the late 1960's. This detection decrease has been recognized in South and Central America, Mexico, the Kuriles, the Caribbean, Tonga, and the New Hebrides. In this paper the effect of the closure of these arrays on the reporting of events in the Aleutian Island Arc is examined.
In the Aleutians, the detection history is complicated by the short-term installation of a local network on and near Amchitka Island during the early 1970's. The temporal coincidence of the installation of this network and the closure of the VELA arrays delayed the detection decrease in the central Aleutians until the Amchitka network was closed in early 1973. Reporting in the eastern Aleutians was unaffected by the installation of the Amchitka network. In that region the detection decreased between 1968 and 1970, the time of the closure of the VELA arrays.
New techniques have been developed which make it possible to determine the effect of station installation or closure on the reporting in some region. These techniques rely on plots which show the distribution of an observed seismicity rate change in the magnitude domain. These plots make it possible to recognize probable detection changes and to quantitatively determine magnitude cutoffs which avoid these changes. The magnitude level at which these cutoffs are made is termed the minimum magnitude of homogeneity (m_{minh}). The reporting of events with $m_b \leq 4.6$ in the Aleutians decreased substantially during the mid-1970's so m_{minh} in this region is 4.7. This is different than the magnitude of completeness (m_{minc}) which is $m_c = 5.0 \pm 0.1$.
If one is interested in examining seismicity rates for changes which may be precursors to earthquakes, then awareness of detection related changes and magnitude cutoffs which avoid those changes are essential for meaningful results. (Detection, Aleutians).
J. Geophys. Res., Red, Paper 3B0270

Social Sciences

7399 General (Social Sciences)
RESERVOIR MANAGEMENT: A RELIABILITY PROGRAMMING APPROACH
Miguel A. Mariño (Department of Land, Air and Water Resources and Department of Civil Engineering, University of California, Davis, California 95616) and Bohzad Mohammadi
A reliability programming model is developed to determine the optimum monthly releases from a multipurpose reservoir. The model is based on chance-constrained linear programming (CCLP) and dynamic programming (DP). The flood and drought reliabilities are represented in the CCLP in the form of chance constraints. Those reliabilities are varied parametrically from their minimum required levels to their maximum possible values. The tradeoffs between flood and drought reliabilities are made using a forward two-dimensional DP routine. The model does not require equal flood and/or drought reliabilities during the year. Folsom reservoir of the California Central Valley Project is modeled to demonstrate the use of this reliability programming approach. The resulting operation policy shows high reliabilities of flood and drought during winter and summer months, respectively. The variable risk levels avoid unnecessary releases during summer (for flood protection) and unnecessary storage of water during winter (for drought protection).
Water Resour. Res., Paper 3W0519

Solar Physics, Astrophysics, and Astronomy

7720 Electromagnetic radiation
Solar Variability in the Spectral Range 2350-2870 A
L. A. Hall (Air Force Geophysics Laboratory, Bedford, Massachusetts, 01731)
Between April 1977 and April 1981, four balloon flights of a solar ultraviolet spectrometer were made to altitudes near 40 km in the stratosphere. Analysis of these measurements shows that the solar irradiance in the wavelength range 2350-2870 A has been constant within ± 7% over this period. The central emission cores of the Mg II resonance lines increased in intensity by about 20% over the same time period. (Solar ultraviolet irradiance, stratosphere)
J. Geophys. Res., Green, Paper 3C0573

Tectonophysics

8130 Heat flow (Extensional Basins)
EVOLUTION OF THE PANNONIAN BASIN SYSTEM
2. SUBSIDENCE AND THERMAL HISTORY
Leigh Royden (Department of Earth and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 and Department of Geological Sciences, Harvard University, Cambridge, Massachusetts 02138), F. Horvath (Geophysical Department, Eötvös University, Kun Bela ter 2, H-1083 Budapest, Hungary), A. Nagymarosy (Geological Department, Eötvös University, Museum krt 4/6, H-1088 Budapest, Hungary), and L. Stegena (Cartography Department, Eötvös University, Kun Bela ter 2, H-1083 Budapest, Hungary)
Analysis of sedimentation and thermal data indicates that, for most parts of the Pannonian basin, observed heat flow, rates of thermal subsidence and vitrinite reflectance [illegible] a uniform extension model for basin formation in late Miocene time. A modified extension model, whereby large amounts of heat are added to the uppermost mantle during extension produced results in good agreement with observation and could also account for periods of uplift observed during extension. Crustal extension beneath most parts of the basin is estimated to have been about 80% to 170%. On the basis of tectonic and structural data, the Vienna basin has been interpreted as the result of thin-skinned extensional tectonics above a shallow detachment surface within the upper crust. Analysis of thermal and subsidence data from the northern Vienna basin suggests that little or no heating occurred during basin extension. These data are consistent with a thin-skinned extensional origin for the Vienna basin. This study emphasizes the need for good thermal, subsidence and structural data in making reconstructions of extensional and thermal histories of sedimentary basins. When such data are available, it is found that a simple uniform extension model does not explain very well the evolution of some sedimentary basins, such as the Vienna and Pannonian basins. In the first instance, the basin is thought to be the result of upper crustal extension only, due to its special tectonic setting, in the second instance, the extra heating during extension is due to some unknown processes in the lower lithosphere that may be a general feature of lithospheric extension. Thus lithospheric extension (and associated heating) may be distributed in a variety of ways; not all extensional basins form in the same way. Application of a uniform subsidence model to basins for which good thermal, subsidence and structural data are not available can lead to reconstructions of thermal histories in error by a factor of 2 or more. (Extensional basins, subsidence histories, thermal analysis).
Tectonics, Paper 3T0091

8130 Tectonophysics (Plate tectonics)
DEVELOPMENT OF FOREARCS OF INTRAOCEANIC SUBDUCTION ZONES
Neil Lundberg (Earth Sciences Board, University of California, Santa Cruz, California, 95064)
The uplifted Costa Rican forearc landward of the Middle America Trench and the Mariana forearc drilled on IPOD leg 60 both lack the thick clastic sequences, complex deformation, and abundant evidence of accretion which characterize more widely known forearcs that border continents. Both regions contain significant in situ accumulations of pelagic and hemipelagic sediments in place of thick trench and trench slope basin sequences composed of terrigenous turbidites. The Nicoya Peninsula of Costa Rica contains no significant melange terranes. Deformation of the mafic igneous basement and its thin cover of pelagic, hemipelagic, and first-cycle volcanogenic material is mild overall, with discrete zones of intense deformation disrupting otherwise well-preserved stratigraphic sections. Intraoceanic subduction zones lacking longitudinal trench feed are sites of little or no accretion of sediments, and recently suggested experimental and theoretical models of subduction zone processes involving flow melanges are inappropriate for intraoceanic forearcs. Intraoceanic forearcs generally lack high-grade exotic components such as blueschist and eclogite tectonically incorporated as blocks in lower-grade matrix, although uplift and erosion of the forearc basement may provide detritus of amphibolite and ultramafic rock to the trench and trench slope.
Tectonics, Paper 3T0133

8150 Plate tectonics
A SEISMIC GAP ALONG AN ACCRETING PLATE BOUNDARY: EXAMPLE OF THE DJIBOUTI RIDGE, AFAR, EAST AFRICA
J.C. Ruegg and J.C. Lépine (Laboratoire d'Etude Géophysique des Structures Profondes, Institut de Physique du Globe, 4 place Jussieu, Tour 14, 75230 Paris Cedex 05, France).
A segment of the Gulf of Tadjoura (Djibouti, East-Africa) accreting plate boundary, shows a period of quiescence in the seismic activity since 1974. This segment corresponds to the extension area of the aftershock activity that has occured after a cluster of magnitude 5.5 earthquakes in April 1973. From this example we propose that the seismic gap concept can be extended to moderate earthquakes occuring at extensional plate boundaries. The magnitude of the largest earthquakes at the spreading axis is limited by the size of the rupture length and by the strength of the brittle lithosphere. In the case of the Djibouti ridge recurrence time of 10-20 years are found for earthquakes of about M = 6.
Geophys. Res. Lett., Paper 3L0390

8150 Plate Tectonics (Extensional Basins)
EVOLUTION OF THE PANNONIAN BASIN SYSTEM
1. TECTONICS
Leigh Royden (Department of Earth and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 and Department of Geological Sciences, Harvard University, Cambridge, Massachusetts 02138), Ferenc Horvath (Department of Geophysics, Lorand Eötvös University, Budapest, Hungary), and János Rumpler (Geophysical Exploration Company, National Oil and Gas Trust, Budapest, Hungary)
The Carpathian arc formed during Cretaceous to Miocene time by continental collision between Europe and smaller continental fragments following southward and westward subduction of ocean floor. During the last stages of thrusting in the outer Carpathians, a set of discrete basins formed behind the Carpathian loop. These basins are regions of middle to late Miocene extension and are connected to each other and to areas of coeval shortening in the outer Carpathian thrust belt by a conjugate system of strike-slip faults. Palinspastic reconstruction of the basins indicates about 100 (±50) km of east-west extension across the intra-Carpathian region during this time. We interpret the Vienna basin, which is superimposed partly on the flysch nappes of the outer West Carpathians, as the result of thin-skinned extensional tectonics above a shallow detachment surface within the crust. Extension of upper crustal rocks above this detachment was probably accomodated by thrusting of the outermost nappes of the West Carpathians over the European platform. Extension of basins farther inside the Carpathian loop probably involved rocks at deeper crustal levels and within the upper mantle. The most internally situated basins formed by extensional processes that involved the entire lithosphere. Thus the depth to which extension occurred seems to be closely related to the proximity of each basin to the active thrust front in the Carpathians. This can be related to the geometry of the subduction zone. Extension within the intra-Carpathian basins began first in the northernmost basins and migrated southward and eastward over a ten million year period. Palinspastic reconstruction of the basins at 17.5, 16.5 and 13.0 Ma predicts eastward migration of the zone of thrusting and shortening within the Carpathian mountains to accomodate the synchronous eastward and southward migration of areas of extension. From these reconstructions, about 120 (±60) km of east-west shortening is predicted across the outer East Carpathians from about 17.5 Ma until present. Both predictions are in good agreement with the timing and magnitude of shortening in the Carpathian thrust belt as determined directly from rocks within the belt. From this we infer a close relationship for middle to late Miocene extension of the intra-Carpathian region and middle to late Miocene crustal shortening within the outer Carpathians. (Strike-slip faults, extensional basins, tectonic reconstructions).
Tectonics, Paper 3T0090

8150 Plate tectonics
THE DRIVING MECHANISM OF PLATE TECTONICS: RELATION TO AGE OF THE LITHOSPHERE AT TRENCHES
P. L. Carlson (Geophysics Department, Texas A&M University, College Station, Texas, 77843), T. W. C. Hilde and S. Uyeda
Sea-floor age-depth and age-trench-depth relations suggest that the oceanic lithosphere continues to thicken and subside with age beyond 80 Ma. If so, slab-pull and ridge-push forces can be calculated from the age of the sea floor at trenches, and if the shear stress acting on the base of the plate increases with absolute velocity, the approximate force balance equation is

[illegible]

where [illegible] and [illegible] are constants related to drag, slab pull and ridge push, respectively. The relation between velocity and age is

[illegible]

We have tested this model by linear regression using rate and age data for 15 trenches:

[illegible]

The strength of this correlation [illegible] is strong evidence in favor of the validity of this simple model. These results suggest that ridge push is just sufficient to overcome drag at the base of the plate, and does not contribute significantly to the motions of oceanic plates, though the value of [illegible] is consistent with the motions of plates not attached to subducted slabs.
Geophys. Res. Lett., Paper 3L0260

8170 Structure of the lithosphere
TECTONIC STRESSES IN THE LITHOSPHERE
L. Fleitout (Laboratoire de Géophysique, Université Paris-Sud, 91405 ORSAY, France), C. Froidevaux
Various types of observables (earthquake focal mechanisms, in situ measurements and geological deformations) give information about the large scale lithospheric stress field. The latter has often been explained by postulating appropriate forces acting at the edges and beneath the plates. This approach ignores the role of mass heterogeneities within the lithosphere. Here we analyse the effect of both boundary and internal forces on the stress pattern and show that both contributions are of comparable magnitude. The presence of internal sources makes the problem three-dimensional. We show however that it can be reduced to a 2-dimensional plane stress formulation, whereby the edge forces are expressed by the "non hydrostatic stresses" and the basal shear is increased by the addition of a term proportional to the gradient of the mean vertical stress. For the oceanic lithosphere we derive a compression which increases with age. The comparison with geophysical observables yields an upper bound of a few bars on the magnitude of the basal drag. For the continents we infer the existence of an underlying upper mantle somewhat denser than under oceans.
Tectonics, Paper 3T0168

8170 Structure of the lithosphere
THERMAL PARAMETERS OF THE OCEANIC LITHOSPHERE ESTIMATED FROM GEOID HEIGHT DATA
A. Cazenave, B. Lago and K. Dominh (Groupe de Recherches de Géodésie Spatiale, Centre National d'Etudes Spatiales, 18, Avenue Edouard Belin, 31055 Toulouse Cédex - France)
Geoid height anomalies derived from SEASAT altimeter data have been analysed across fracture zones and over ocean ridges in two limited regions of the South Pacific (Eltanin fracture zone system ; East Pacific Rise) and Southeast Indian Ocean. Observed geoid height - age and geoid height derivative (with respect to age)- age relationships have been established. Comparison with theoretical relationships computed for the plate model of lithospheric cooling permits an estimation of the thermal parameters entering in the model. Two quantities can be derived : the product $\alpha \times T_m$ (κ, thermal diffusivity ; α, volume coefficient of thermal expansion ; T_m, bottom boundary temperature) and the thickness H of the plate. The best fitting values for the South Pacific and the Southeast Indian Ocean are : $\alpha \times T_m = 0.32 \times 10^{-3}\ cm^2s^{-1}$ and H in the range 50-70 km for ages less than 30 myr whereas for larger ages (> 30 myr), geoid observations are better explained by a larger H value, in the range 70-90 km. The depth-age relationship observed in the South Pacific region is consistent with these parameters. On the other hand, data for the Northeast Pacific argue rather for a lithospheric thickness larger than 100 km. This suggests that local and regional variations exist in the thermal properties of the oceanic lithosphere.
J. Geophys. Res., Red, Paper 2B1780

8199 General
STRUCTURAL ANALYSIS AND INTERPRETATION OF THE SURFACE DEFORMATIONS OF THE EL ASNAM EARTHQUAKE OF OCTOBER 10, 1980
H. Philip (Laboratoire de Géologie Structurale, Université des Sciences et Techniques du Languedoc, 34060 Montpellier cédex, France), M. Meghraoui
The El Asnam earthquake of October 10, 1980, represents the major seismotectonic event of these last decades in the West Mediterranean area. It has induced a large amount of surface breaks. This earthquake reveals the importance of compressional phenomena that characterise nowadays the tectonics of North Africa. The tectonic analysis of surface rupture shows the complexity of the deformation mechanism. The principal mechanism consists of the activation of a NE-SW trending thrust fault, accompanied with a left-lateral rotation and with an intense deformation of the north-western overthrusting block. An accurate description of these deformations shows that, for a large part, the breaks geometry depends closely on the substratum structure. Finally, the analysis of the dislocations on irrigation ducts just above the fault traces allowed a quantitative study of the deformation. (El Asnam earthquake, North Africa, Surface ruptures, Seismotectonic).
Tectonics, Paper 3T0237

Volcanology

8699 Volcanology topics
LONG VALLEY/MONO BASIN VOLCANIC COMPLEX
J. F. Hermance (Department of Geological Sciences, Brown University, Providence, RI 02912)
The Long Valley/Mono Basin volcanic complex in eastern California is one of the few major silicic systems in western North America which may still be potentially active. These complexes are typically associated with highly developed hydrothermal convective systems and hot spring activity at the surface. They have been studied for many years by workers interested in metallogenesis, the mitigation of volcanic and earthquake hazards, and the development of conventional and non-conventional forms of geothermal energy. The status of some of this work as it relates to the Long Valley/Mono Basin volcanic complex is reviewed by way of a progress report. Although a great deal of exciting research is presently underway, much yet needs to be done.
One research technique which has not been exploited is scientific drilling to intermediate depths (2 - 3 km). A carefully structured research program in which scientific drilling is closely integrated with surface geological and geophysical field studies would help clarify many of the present issues concerning this volcanic complex.
Rev. Geophys. Space Phys., Paper 3R0259

8699 Volcanology
SEISMIC ACTIVITY RELATED TO THE MARCH-APRIL, 1982 ERUPTIONS OF EL CHICHON VOLCANO, CHIAPAS, MEXICO
J. Havskov (Instituto de Ingeniería, U.N.A.M., C.U., México 04510, D.F.), S. De la Cruz-Reyna, S.K. Singh, F. Medina, and C. Gutiérrez
Interesting seismic activity occurred before, during, and following the recent eruptions of El Chichon Volcano in southeastern Mexico. Several eruptions took place in late March and early April 1982, ejecting large amounts of andesitic ash and pumice. The first eruption was preceded by one month of intense shallow seismicity (h=5 km). Two days before the first eruption of March 29, the seismicity changed character and was most likely shallow (h=2 km). This shallow seismicity continued until the last and probably largest eruption on April 4, after which only deep seismicity was observed (h=15 km). The different nature of shallow events and deep events suggest that the former are directly related with the magma movements and ground water interactions while the latter are probably controlled by regional tectonic stresses, acting on the weakened region left by the eruption at those depths. (El Chichon, prediction of volcanic eruptions, seismicity and eruption).
Geophys. Res. Lett., Paper 3L0203

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